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HEARING
BEFORE THE
SUBCOMMITTEE ON
OVERSIGHT AND INVESTIGATIONS
OF THE
COMMITTEE ON COMMERCE
HOUSE OF REPRESENTATIVES
ONE HUNDRED FOURTH CONGRESS
FIRST SESSION

ON
TITLE VI—OZONE DEPLETING SUBSTANCES

AUGUST 1, 1995

Serial No. 104-52

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(III)

CLEAN AIR ACT AMENDMENTS

Title VI—Ozone Depleting Substances

TUESDAY, AUGUST 1, 1995.

HOUSE OF REPRESENTATIVES,
COMMITTEE ON COMMERCE,
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m., in room 2322, Rayburn House Office Building, Hon. Joe Barton (chairman) presiding.

Members present: Representatives Barton, Cox, Franks, Burr, Bliley (ex officio), Wyden, Furse, Klink, and Dingell (ex officio).

Also present: Representatives Bilbray, Farr, and Miller of Florida.

Staff present: Bob Meyers, majority counsel; Stephen Sayle, majority counsel; Reid Stuntz, minority general counsel and William Tyndall, minority counsel.

Mr. BARTON. The subcommittee will come to order.

Today is the ninth hearing that we have held on the 1990 Clean Air Act Amendments. The focus of the hearing today will be on Title VI of the 1990 Amendments. Title VI of the Clean Air Act amendments establishes a program for the phaseout of the ozone-depleting substances. The most familiar of these are chlorofluorocarbons, or CFCs, which are primarily used in refrigeration and air conditioning.

However, methyl bromide, which is not exactly a household word, is also thought to be an ozone depleting substance and will be a primary focus of our hearing today. As many of you know, Title VI of the Clean Air Act is unusual in that it is intended as a supplement to the Montreal Protocol. When there is a conflict between provisions in this act and the protocol, the more stringent governs U.S. policy.

Past agreements between the parties to the Montreal Protocol have resulted in accelerated phaseouts of various substances. Parties to the Montreal Protocol are scheduled to meet again in November of this year, at which time phaseout schedules for hydrofluorocarbons, or HFCs, may be accelerated still further.

Many of the Clean Air Act issues that this subcommittee has examined begin with the underlying science. Science is again at the center of this debate. Today, we will have testimony presented by Dr. Robert Watson from the Office of Science and Technology Policy, and Dr. Fred Singer, Professor Emeritus of Environmental Sciences at the University of Virginia.

Dr. Watson will be testifying that available evidence appears to strongly indicate that ozone depletion is occurring and that it is linked to man-made substances. Dr. Singer believes that current scientific evidence does not support such a conclusion and also does not support a ban on CFCs or methyl bromide.

The costs of these phaseouts will be great. Some studies estimate the cost as high as \$99 billion. One noted economist has called it the biggest tax increase in history. At the very least, it will require every family to spend hundreds, perhaps thousands, of dollars to replace consumer goods that utilize CFCs.

In studying the implementation of Title VI, today's hearing will also address methyl bromide. Methyl bromide is a fumigant used in pretreating soil, in fumigating produce and grains for shipment and quarantine as well as other agricultural purposes. It is due to be phased out by the year 2001 under provisions of the 1990 Amendments. There is no known "drop in" substitute for this substance.

With this brief background, let us begin the hearing. I would like to recognize the ranking minority member, Mr. Wyden of Oregon, for an opening statement.

Mr. WYDEN. Thank you, Mr. Chairman. Mr. Chairman, and colleagues, the Ozone Protection Program is testament to the proposition that markets work. By creating demand for substitute products that don't harm the ozone layer, the act has clearly created new opportunities for business to market new products and to improve productivity in our country.

Instead of examining the successful track record of developing alternatives to chlorofluorocarbons and other ozone depleting chemicals, the subcommittee today is focusing on one area, methyl bromide, where more does need to be done. By focusing only on methyl bromide, it seems to me that the subcommittee gets a distorted picture of the overall Ozone Protection Program.

The fact is there is an overwhelming scientific consensus that depletion of the ozone layer is a serious problem, that methyl bromide is a significant contributor to the problem and that if the problem isn't addressed, there will be increased cases of skin cancer, cataracts, and suppressed immune systems among our citizens. The small minority of critics who say otherwise are simply wrong.

Having said that, at the moment there aren't cost-effective alternatives for every use of methyl bromide and this is a legitimate cause for concern in our agricultural community. But with the deadline for phasing out methyl bromide more than 5 years away, it seems a bit premature to say that the "sky is falling."

There also wasn't any viable CFC alternative 5 years before the Clean Air Act's CFC phaseout deadline and we all know we still have air conditioning in our cars, homes, and workplaces.

CFCs are one of the ozone depleting chemicals where the Clean Air Act's market-oriented approach has worked. The act's phaseout of CFCs created demand for non-ozone depleting alternatives and industry responded to this opportunity by developing effective alternatives in time to meet the phaseout deadline. Automobiles built in the last few years were equipped with air conditioners that work without CFCs. For older model cars, there are ways to retrofit automobile air conditioners for less than \$100.

For the cases where retrofitting is not cost-effective there are currently sufficient supplies from recycling and past production of CFCs to keep these air conditioners running for the rest of their useful lives.

The real world experience with CFCs shows that the idea of new technologies emerging to replace methyl bromide in the next few years is a reasonable expectation and not pie-in-the-sky wishful thinking. By letting the process of technological innovation run its course, we could have our ozone layer to protect us from harmful ultraviolet radiation and still have the strawberries and the tomatoes that the American people love.

According to the Montreal Protocol's Methyl Bromide Technical Options Committee technically feasible alternatives already exist for 90 percent of the current uses of methyl bromide. There are currently research efforts under way to identify alternatives for the remaining cases. The challenge will be to find equally effective alternatives for the last 10 percent of methyl bromide uses before the 2001 phaseout deadline.

If cost-effective alternatives aren't developed by 2001, the phaseout of methyl bromide could be disruptive to many sectors of U.S. agriculture, including nursery crops grown in my home State of Oregon. Methyl bromide is also used to fumigate imported logs to eliminate risks of importing non-native pests that could devastate forests in the Northwest and other parts of the country.

With these high stakes for nursery and produce growers and the forest products industry, it is critical that effective alternatives to methyl bromide be developed in time to meet the 2001 phaseout deadline. Under the act's safe alternative policy, the EPA is required to work with the Department of Agriculture and other Federal agencies to assist in identifying alternatives to ozone depleting chemicals and achieving the transition to these alternatives.

We are interested in hearing from the EPA and other Federal Government witnesses about what they are doing to comply with these requirements and how to ensure that in 2001 a crisis does not come down on the heads of our citizens. Thank you, Mr. Chairman, I look forward to the testimony.

Mr. BARTON. Thank you, Mr. Wyden and the Chair announces there will be a pop quiz on each of the two opening statements at the end of the testimony today so I hope you took note on that.

We would like to now welcome our first panel.

Mr. WYDEN. Mr. Chairman, with your indulgence, I would just ask unanimous consent that the statement of Mr. Dingell be entered in at this point.

Mr. BARTON. Without objection so ordered and all other members of the subcommittee will have the same rights.

[The prepared statements of Hon. Michael Oxley, Hon. John D. Dingell and Hon. Ron Wyden follow:]

PREPARED STATEMENT OF HON. MICHAEL OXLEY, A REPRESENTATIVE IN CONGRESS
FROM THE STATE OF OHIO

Thank you, Mr. Chairman for this opportunity to speak and for holding this important hearing.

I suspect that if someone had told us about methyl bromide back in the late 1980's when we debated and adopted the Clean Air Act Amendments, we might not

be having this hearing. I can't imagine that we would have placed our nation's food supply in this precarious position.

At least insofar as methyl bromide is concerned, the Act is flawed and I have already called on the full Committee to make appropriate adjustments. We can fix this mess before it goes much farther.

But, Mr. Chairman, I am truly dismayed by reports of EPA's management of this issue.

I was astonished to learn that EPA officials knew so little about methyl bromide just four years ago that they said that it was used just for "ornamental shrubs, turf and luxury foods."

I was dismayed to learn that an EPA official told an international audience that it would be "tough" if our tomato growers ended up with no alternatives.

I was amused by reports that yet another EPA official—speaking to farmer concerns about this issue—recently claimed that California farmers would be no factor in the upcoming elections.

Mr. Chairman, if I may be permitted to ask a question of Assistant Administrator Nichols: Ms. Nichols, since all three of these incidents have been widely reported, I assume you are aware of them. What assurances can you provide to this Congress that your staff is working for and not against American interests?

PREPARED STATEMENT OF HON. JOHN D. DINGELL, A REPRESENTATIVE IN CONGRESS
FROM THE STATE OF MICHIGAN

Thank you, Mr. Chairman. This hearing on Title VI of the Clean Air Act Amendments of 1990 is timely, for three reasons: (1) it is important to note the success of the implementation of the phaseout of CFCs; (2) we should hear the very legitimate concerns of farmers about the phaseout of methyl bromide; and (3) our Republican friends have just voted to gut EPA's budget, thereby jeopardizing the ability of the agency to implement this and other provisions of the Act in a flexible and timely manner.

First, EPA's collaborative implementation of the phaseout of CFCs averted inconvenience and economic harm to consumers, producers, and industry. In particular, the transition to non-ozone-depleting refrigerants in motor vehicle air conditioners appears to be going relatively smoothly, albeit not without costs. Indeed, I continue to hear complaints about the high-cost of auto air conditioning retrofit costs. I intend to make an inquiry into these and other issues as implementation continues.

Second, major concerns have been raised by farmers about phasing-out methyl bromide before suitable alternatives are available. Certainly methyl bromide is a very toxic pesticide. Yet it also has many critical uses for agriculture. And the scientific concern about its ozone-depleting properties appears well-supported. But we should not therefore run roughshod over the interests of farmers, nor should we hobble them in international competition. We need flexibility, and we need time for more alternatives to be developed. EPA has expressed its readiness to work on regulatory approaches to allow applications for "essential use" exemptions, and I applaud them.

Finally, I note that the EPA budget cuts in the VA-HUD Appropriations bill will likely do more to undercut responsible implementation of the Clean Air Act than any number of environmental zealots. All the oversight hearings in the world will not be able to make up for the damage and disarray that will be the fallout as the agency scrambles to absorb these huge losses with only a few weeks to plan. The Agency will be forced to throw major programs overboard with little time to contemplate its options. EPA, responsible businesses, and our citizens will all be the losers from these hastily considered and intemperate cuts.

PREPARED STATEMENT OF HON. RON WYDEN, A REPRESENTATIVE IN CONGRESS FROM
THE STATE OF OREGON

The ozone protection program is testament to the proposition that markets work. By creating demand for substitute products that don't harm the ozone layer, the Act has created new opportunities for business to market new products and to improve productivity.

Instead of examining the successful track record of developing alternatives to chlorofluorocarbons (CFCs) and other ozone depleting chemicals, the Subcommittee has chosen to focus today's hearing on one area—methyl bromide—where more needs to be done. By focusing only on methyl bromide, the Subcommittee gets a distorted picture of the ozone protection program.

The fact is there is an overwhelming scientific consensus that depletion of the ozone layer is a serious problem, that methyl bromide is a significant contributor to the problem, and that if the problem isn't addressed, there will be increased cases of skin cancer, cataracts and suppressed immune systems. The small minority of critics who say otherwise are wrong.

Having said that, at the moment, there aren't cost effective alternatives for every current use of methyl bromide, and this is a legitimate cause for concern in the agriculture community. But with the deadline for phasing out methyl bromide more than 5 years away, it seems a bit premature to be saying "the sky is falling."

There also wasn't any viable CFC alternative 5 years before the Clean Air Act's CFC-phaseout deadline, and yet we still have air conditioning in our cars, homes and workplaces.

CFCs are one of the ozone depleting chemicals where the Clean Air Act's market-oriented approach has worked. The Act's phaseout of CFCs created demand for non-ozone depleting alternatives. And industry responded to this opportunity by developing effective alternatives in time to meet the phaseout deadline.

Automobiles built in the last few years are equipped, with air conditioners that work without CFCs. For older model cars, there are ways to retrofit automobile air conditioners for less than \$100. And for the cases where retrofitting is not cost effective, there are currently sufficient supplies from recycling and past production of CFCs to keep these air conditioners running for the rest of their useful lives.

The real world experience with CFCs shows that the idea of new technologies emerging to replace methyl bromide in the next few years is a reasonable expectation, not "pie in the sky" wishful thinking. By letting the process of technological innovation run its course, we could have our ozone layer to protect us from harmful ultraviolet radiation and still eat strawberries and tomatoes too.

According to the Montreal Protocol's Methyl Bromide Technical Options Committee, technically feasible alternatives already exist for 90 percent of the current uses of methyl bromide. And there are currently research efforts underway to identify alternatives for the remaining uses.

The challenge will be to find equally effective alternatives for the last 10 percent of methyl bromide uses before the 2001 phaseout deadline.

If cost-effective alternatives aren't developed by 2001, the phaseout of methyl bromide could be disruptive to many sectors of U.S. agriculture, including nursery crops grown in my home state. Methyl bromide is also used to fumigate imported logs to eliminate risks of importing non-native pests that could devastate forests in the Northwest and other areas of the country.

With these high stakes for nursery and produce growers and the forest products industry, it's critical that effective alternatives to methyl bromide be developed in time to meet the 2003 phaseout deadline.

Under the Act's Safe Alternative's Policy, the EPA is required to work with the Department of Agriculture and other Federal agencies to assist in identifying alternatives to ozone depleting chemicals and in achieving the transition to these alternatives. I will be interested in hearing from the EPA and other Federal government witnesses about what they are doing to comply with these requirements and how they will ensure that in 2001, a crisis doesn't come crashing down on our heads.

Mr. BARTON. Each of you are aware that it is the tradition of this subcommittee to take testimony under oath.

Do any of you have objection to testifying under oath? I think you are also aware that you have the right to counsel. Would any of you wish to bring forward a counselor to help you with your testimony?

Then if you will please stand and raise your right hands.

[Witnesses sworn.]

Mr. BARTON. We have some distinguished Members of Congress here that have some constituents on the first panel and would like to personally introduce their constituent to our subcommittee. The Chair would recognize Mr. Farr to introduce his constituent.

Mr. FARR. Well, thank you very much, Mr. Chairman. I couldn't help but note your words that methyl bromide may not be a household word, but I can tell you that it is a backyard word where I live because we use more methyl bromide than any other region of the United States. I live on the central coast of California. We grow

about 120 different crops there and they are all dependent upon, most of them are dependent upon effective herbicides and pesticides.

And the difficulty we have is that there is, as you and Mr. Wyden pointed out, there is phaseout in the year 2001 and it is sort of a race between now and a time line as to whether the farmer is going to have adequate tools to be able to face what's ahead of them and it's also one of great uncertainty.

Dealing in agriculture is always uncertain with nature as it is, but to add this sort of where do we put our investment in the next 5 years, do we move offshore, do we go to another country that's competitive? The protocols have been developed for methyl bromide, for example, to export not only using in the ground but to export a lot of our products. The protocols of the countries that we export to require that we treat them with methyl bromide before those products can enter into another country, as Mr. Wyden was pointing out.

So the use of methyl bromide is very broad and the uncertainty that this policy that we have adopted puts farmers I think at a lot of risk. And that's what I wanted to bring to you today.

I brought a friend, other panel members are friends, too. I've worked with Tom Pavich for many years on some good legislation. But particularly I wanted to introduce you to Clint Miller from Watsonville. Clint is probably one of the best strawberry growers in the world and he—

Mr. BARTON. Probably.

Mr. FARR. Well, we think so.

Mr. BARTON. For you he is the best strawberry grower in the world.

Mr. FARR. And his wife, Karen. They both are here today and they operate Clint Miller Farms on 250 acres just south of Watsonville, California near the Pajaro River. And many of you may have heard about the Pajaro River because it was one of the one of the biggest floods in history in the Pajaro Valley and strawberry farmers along the riverside were just totally wiped out as Mr. Miller was. And he is here today to talk to you about what he sees as a farmer on the land and what they are facing.

I just wanted to point out that I think we've committed ourselves in Congress to putting some research money into the alternatives, but what I don't think that we've done very effectively is really made it a major strategic issue.

If indeed we are going to find an alternative, I am not sure we are getting there fast enough and I am not sure we're communicating with the people that actually have to plant. That is that there is an ivory tower kind of academic approach to research and then there is the actual applied research.

And my comment to this committee having been involved in this for a number of years is I think we really need to make war if indeed we are going to phaseout methyl bromide by the year 2001. And although Congress is committing \$28 million this year and next year to methyl bromide research, the research has yet to find any commercial alternatives for strawberries and many other crops.

And if we cannot find the alternative, then I think Congress should consider extending the phaseout of methyl bromide uses with no—as long there is no effective alternative. The agricultural economies cannot afford to lose the methyl bromide tool without an effective replacement, especially when our foreign competitors continue to use methyl bromide.

So Mr. Chairman, in the only inhabitable planet that we know of that is suffering from ozone depletion at its poles, ozone loss is a threat that we cannot afford to disregard or treat lightly. Most of the science that we have now says that methyl bromide plays a part in the loss of stratospheric ozone, but if we are still several years away from finding alternatives to the 2001 drop-dead deadline, I can see no justification for sacrificing the strawberries that Clint Miller grows and the rest of the central coast to meet an arbitrary deadline.

So Mr. Chairman, I thank you for allowing me to come to the subcommittee and for your attention on this important issue and look forward as a representative from the California 17th Congressional District, as a member of the House Agriculture Committee to work with you on this important issue and I would also, if you don't mind, like to submit for the record testimony of David Riggs, who is President of the California Strawberry Commission and Chairman of the Crop Protection Coalition and his report on the status of methyl bromide alternative research activities.

[The statement of David Riggs follows:]

STATEMENT OF DAVID RIGGS, CHAIRMAN, CROP PROTECTION COALITION

Mr. Chairman, Members of the Subcommittee, I am David Riggs, President of the California Strawberry Commission, and I am here today in my capacity as Chairman of the Crop Protection Coalition (CPC). We are a coalition of thirty (30) fresh fruit and vegetable producers, associations, cooperatives and related industries from across the nation. While diverse in our commodities and divergent in the unique aspects of our own industries, we are united in common dependence upon the availability and use of the fumigant methyl bromide for the production and marketing of our products.

As a result of the November 1992 meeting in Copenhagen of the United Nations Treaty on international control of ozone depleting substances, methyl bromide was listed as an "Ozone Depleting Substance." Under the authority of the Title VI of the Clean Air Act, which is the focus of today's hearing, the Environmental Protection Agency (EPA) on December 10, 1993 so identified and listed methyl bromide as a class I ozone depleting substance with a complete phaseout of production and importation by January 1, 2001. The Clean Air Act creates an inequity between United States agriculture and agriculture in other countries since such other countries are not similarly bound by the rigid phase-out date.

The impact of this regulatory action creates great uncertainty for our coalition members and for many engaged in food production and marketing because unlike ozone depleters that are being phased out in non agricultural industries, there are currently NO ALTERNATIVES for most agricultural uses of methyl bromide. This pesticide/fungicide has been extensively utilized over the past three decades as the standard treatment and, in many cases, the only treatment for pests and diseases both pre and post harvest.

First is the use of the pesticide as a pre-plant fumigant. The chemical helps control significant soilborne pathogens, insects, nematodes and weeds in the soil. The elimination of these plant pests, nematodes, and diseases assists in the production of wholesome food. In many cases the use of this preplant treatment leads to healthier plants, thus providing the foundation for Integrated Pest Management (IMP) systems. This, in turn, leads to the reduced need for pesticides during the growing season and more efficient use of land, water and other resources. If methyl bromide or a similar crop protection tool is not available, it will be extremely difficult, and for some crops almost impossible, to produce or market various commodities in an economically viable manner.

Second is the use of methyl bromide as a post-harvest fumigant. Frequently, after harvest, agricultural commodities require treatment with methyl bromide to meet federal, state or international regulatory requirements. Treatment may also be required by receiving customers to assure the food complies with contract specifications for insect or rodent infestations. Unlike soil fumigation which involves injection of the chemical into the soil, post-harvest use of the chemical involves exposure of the food in a fumigation chamber.

Extensive research efforts are underway to identify modifications that can be made in both fumigation chambers and soil fumigation application methods to further reduce emissions of methyl bromide. For example, this includes employing recycling technologies to eliminate the release of the chemical into the atmosphere. For pre-plant treatment, modifications in equipment and tarp density are already reducing emissions significantly.

According to the USDA, approximately 135 different commodities require methyl bromide fumigation as a condition of entry either for import or export. Of these, only 17 have an alternative treatment currently approved, and 25 have no alternative treatment. The other 93 are still being reviewed. Without effective alternatives to methyl bromide, these markets for U.S. exports would be lost and production of some crops may shift to other countries.

A unilateral phase-out by the United States will only shift agricultural reduction to countries that permit methyl bromide use. Since ozone depletion is a global problem, shifting agricultural production abroad results in nothing more than an estimated \$1.5 billion dollar annual loss to US agriculture, a loss of American jobs while achieving no significant reduction in the total amount of methyl bromide released in the environment.

Mr. Chairman and members of this Subcommittee, I want to be perfectly clear. On behalf of the Crop Protection Coalition, we strongly support a clean and healthy environment. In fact, we have been working aggressively with USDA and EPA officials to find suitable alternatives for methyl bromide before the regulatory imposed deadline of January 1, 2001. Unfortunately, we have to date, not been successful.

In the absence of a cost effective and proven alternative for methyl bromide, we believe that it will be necessary for the enactment of legislation to postpone the planned unilateral phase out of methyl bromide in the United States or at least exempt use of commodities where effective alternatives are not available. We look forward to working with this Committee and other interested parties in addressing this critical issue.

Thank you Mr. Chairman for affording me this opportunity to testify on this critical issue for millions of American men and women.

Mr. BARTON. Without objection, so ordered. The Chair would stipulate that for the purposes of today's hearing Mr. Miller is the world's best strawberry grower and would now like to recognize Mr. Dan Miller to introduce, I think he is going to say the world's best tomato grower.

Mr. Miller.

Mr. MILLER OF FLORIDA. We have good strawberries in our area of Florida, too, by the way. My congressional district in Florida is best known for the large number of senior citizens we have along the Gulf coast of Mexico from the south of Tampa to Sarasota and Bradenton and Venice, but it has a significant agricultural population and segment in our economy there, too. A lot of citrus, strawberries, but especially tomatoes.

We have two crops a year in tomatoes, one in the fall and one in the late spring, so it has a very significant impact on our economy. And one of the gentleman on the panel today is one of my constituents from Palmetto, Florida, and is a third generation tomato farmer from that area.

Florida is the largest user of methyl bromide of all the States in the country. A significant amount is used in the tomato crops and I will let Jim explain more of the specifics of the issue. I will be interested in introducing legislation later this week on methyl bromide which includes two things.

One is that we will delay the date of 2001 unless two things happen, either thing happens. One is that there is an economically viable alternative, a cost-effective alternative available, or that the Montreal Protocol bans it for everyone in the world.

When we go through the debate, I remember over trade there is always the issue that free trade is fine as long as it is fair. And that is the whole key on this issue, the question is fairness in this. If we ban it and Mexico doesn't, that is not fair in my books and so that, to me, is one of the issues about having a level playing field in this banning methyl bromide.

Jim is one of the many farmers, these are not big corporate farms, in my district. They are successful farmers who have been doing it for years, but they are having a very difficult time with the competition and with the threat of methyl bromide is totally unfair. So I hope we have some great bipartisan support on this piece of legislation and I really appreciate you, Mr. Chairman, having these hearings and having the real people that work with the product and know the direct impact this will have on their jobs and the future of their local community.

Thank you very much. I look forward to having the comments of Mr. Grainger presented.

Mr. BARTON. Thank you, Congressman Miller, for that introduction.

Before we get around to recognizing you to actually give your testimony, I am informed that the Vice Chairman of the Subcommittee, Mr. Cox, also is acquainted with one of our witnesses, Mr. Pavich.

Would Mr. Cox like to introduce Mr. Pavich before we begin testimony?

Mr. COX. Thank you, Mr. Chairman. I'd like to welcome Tom Pavich here. Pavich Family Farms has been in business for many, many decades—4 decades, in fact. And odds are most of us here in this room have eaten his products since they supply 2 percent of the Nation's table grapes.

Pavich Family Farms has been looking at alternatives to methyl bromide and I'm looking very much forward to hearing your testimony. I want to thank you for making the trip here today.

Mr. PAVICH. You're welcome.

Mr. BARTON. Since we have completed our introductions, I think we may begin to receive our testimony. We are going to start with Mr. Grainger. Your statement and any additional material are submitted for the record.

We ask that you summarize your written statement in 5 minutes or less. We have a little green light. When it is on you can talk, when it turns red time has expired.

So Mr. Grainger, we would like to begin with you.

TESTIMONY OF JIM GRAINGER, GRAINGER FARMS INC.; CLINT MILLER, CLINT MILLER FARMS, INC.; DENNIS ROCHFORD, PRESIDENT, MARITIME EXCHANGE FOR DELAWARE RIVER AND BAY; STEPHEN A. ZILLER, PH.D., VICE PRESIDENT, SCIENCE AND TECHNICAL AFFAIRS, GROCERY MANUFACTURERS OF AMERICA; AND TOM PAVICH, PAVICH FAMILY FARMS

Mr. GRAINGER. Good morning. My name is Jim Grainger. I grow tomatoes, melons, and citrus on my 1,200-acre farm in Manatee County, Florida. I have been in farming all my life as were my parents and their parents before them. Our farm employs nine full-time staff members and as many as 100 part-time farm workers depending on the time of year.

I am told I will lose the use of methyl bromide by January 1, 2001. And I am here to say that if we do indeed lose methyl bromide, my farm and many others will no longer exist. Even with methyl bromide, the number of Florida tomato growers is shrinking.

According to the Florida Tomato Committee, in 1974, Florida had 475 tomato growers. By 1990 the number had dropped to 230 and today there are fewer than 100 of us. To exist we must make a profit and to make a profit two things have to happen.

First, the price must be good for our crops. Second, we must be able to efficiently produce enough fruits and vegetables to take advantage of a good price. It may sound obvious and simple. It is not.

Let me use the example of tomatoes to illustrate the point. In terms of yields, we work hard to produce 2,000 25-pound boxes of tomatoes per acre. We must control pests because we cannot control the weather. With methyl bromide, we are able to rid the soil of nematodes, fungi, insects, and weeds. And, as a result, our plants get off to an excellent start.

We estimate that if we must farm without methyl bromide, our protection will drop 25 percent if the weather conditions are absolutely ideal and 50 percent if the weather is bad during our growing season. Well, before EPA ever considered banning methyl bromide, the Florida Fruit and Vegetable Association was looking for alternatives to methyl bromide. We do not have chemical or nonchemical alternatives to methyl bromide and I am unaware of any which have been proposed.

Mr. Chairman, if we lose methyl bromide, I can expect to produce no more than 1,500 25-pound boxes of tomatoes per acre and perhaps as few as 1,000. My cost of production is a second factor. Before we see a nickel in revenue, we spend approximately \$5,500 per acre to buy plants, prepare the land, add soil sweeteners, fumigate with methyl bromide—which incidentally is about 5 percent of the per acre cost—add fertilizer, install drip tape irrigation, purchase and install plastic to cover the beds and hire the people necessary to plant and tend the tomatoes and run our office, also the purchase of other chemicals to maintain the tomatoes so they'll be pest free.

We then spend about \$6,500 per acre to pick, pack, transport and sell our tomatoes. Therefore, our per-acre cost is about \$12,000. Some farms run a bit more efficiently, but many do not. In most

businesses, the cost of the product or service drives the price. In farming the marketplace sets the price and we live and die by it.

We produce 2,000 boxes per acre and the price is \$7 per box. We generate \$14,000 per acre and a pre-tax profit of \$2,000. But that's absolutely best case. At \$6 per box we're right at the edge and at \$5 we're losing money.

The past spring 1995 season the price per box was as low \$2.50 which meant if we were lucky enough to produce 2,000 boxes per acre, we lost \$6,000 per acre. If we were to have produced 1,500 boxes our loss would have been over \$7,000 per acre. Why was the price per box so low this past year?

We are able and produce and sell tomatoes twice a year. Because of our climate, our tomatoes reach the market from mid March through early June and then again from about the last week of October through February 1.

We compete head to head with Mexican tomato growers whose operating costs are a fraction of ours and who, no thanks to the North American Free Trade Agreement, are aggressively pursuing the U.S. market. On January 1, 2001, when I will no longer have methyl bromide, Mexican growers will be free to use it.

The trends are disturbing to say the least and our 1990 to 1991 season Florida growers shipped 30,463 cars of tomatoes while Mexico growers shipped slightly more than 18,000 and a car is defined by 1,600 boxes, 1,600 25-pound boxes.

We estimate that in the 1994-1995 season, Florida growers will ship 27,560 cars versus 26,600 for Mexico. And at that pace, Mexico will outship next year. We are not afraid to compete, but our government is not allowing us to compete when it tells us that we may no longer use methyl bromide.

I'm a farmer and this is who I am and what I know. If I cannot farm here and make a living, I will farm somewhere, possibly Mexico since the climate and the conditions are about the same. And farming is likely to remain a legal and profitable profession.

Mr. Chairman, I thank you for your concern and the opportunity to testify this morning. I'll be happy to answer any questions.

[The prepared statement of James Grainger follows:]

PREPARED STATEMENT OF JAMES GRAINGER, GRAINGER FARMS, INC.

My name is Jim Grainger. I grow tomatoes, melons and citrus on my 1200 acre farm in Manatee County, Florida. I have been in farming all my life, as were my parents and their parents before them.

Our farm employs nine fulltime staff members and as many as 100 part-time farm workers, depending on the time of year.

I am told I will lose the use of methyl bromide by January 1, 2001 and I am here to say that, if we do indeed lose methyl bromide, my farm and many others will no longer exist. Even with methyl bromide, the number of Florida tomato growers is shrinking. According to the Florida Tomato Committee, in 1974 Florida has 475 tomato growers. By 1990, the number had dropped to 230 and today there are fewer than 100 of us.

To exist, we must make a profit. And to make a profit, two things have to happen.

First, the price must be good for our crops. Second, we must be able to efficiently produce enough fruits and vegetables to take advantage of a good price.

It may sound obvious and simple. It is not. Let me use the example of tomatoes to illustrate the point.

In terms of yields, we work hard to produce 2,000 25-pound boxes of tomatoes per acre. We must control pests because we can't control the weather. With methyl bromide, we are able to rid the soil of nematodes, fungi, insects and weeds—and as a result our plants get off to an excellent start.

We estimate that if we must farm without methyl bromide, our tomato production will drop 25 percent if weather conditions are absolutely ideal and by 50 percent if weather is bad during our growing seasons.

Well before EPA ever considered banning methyl bromide, the Florida Fruit and Vegetable Association was looking for alternatives to methyl bromide. We do not have chemical or non-chemical alternatives to methyl bromide, and I am unaware of any which have been proposed.

Mr. Chairman, if we lose methyl bromide, I can expect to produce to no more than 1,500 25-pound boxes of tomatoes per acre and perhaps as few as 1,000 boxes.

My cost of production is a second factor. Before we see a nickel in revenue, we spend \$5,500 per acre to buy plants, prepare the land, add soil sweeteners, fumigate with methyl bromide—which, incidentally is about five percent of the per acre cost—add fertilizer, install drip tape irrigation, purchase and install plastic to cover the crops, and hire the people necessary to plant and tend the tomatoes, and run our office.

We then spend about \$6,500 per acre to pick, pack, transport and sell our tomatoes. Therefore, our per acre cost is about \$12,000. Some farms run a bit more efficiently, many do not.

In most businesses, the cost of the product or service drives the price. In farming, the marketplace sets the price and we live and die by it.

If we produce 2,000 boxes per acre, and the price is \$7 per box, we generate \$14,000 per acre and a pretax profit of \$2,000. But, that's absolutely best case.

At \$6 per box, we're right at the edge and at \$5 we're losing money.

This past year, the price per box was \$2.50 which meant that if we were lucky enough to produce 2,000 boxes per acre, we lost \$6,000 per acre. If we were to have produced 1,500 boxes, our loss would be over \$7,000 per acre.

Why was the price per box so low this past year? We are able to produce and sell tomatoes twice a year. Because of our climate, our tomatoes reach the market from mid-March through early June and then again from about the last week of October through February 1.

We compete head-to-head with Mexican tomato growers whose operating costs are a fraction of ours and who now, thanks to the North American Free Trade Agreement, are aggressively pursuing the U.S. market. On January 1, 2001 when I will no longer have methyl bromide, Mexican growers will be free to use it.

The trends are disturbing, to say the least. In our 1990-91 season, Florida growers shipped 30,463 cars of tomatoes while Mexican growers shipped slightly more than 18,000. We estimate that in the 1994-1995 season, Florida growers will ship 27,560 cars versus 26,600 from Mexico. At that pace, Mexico will outship us next year.

We are not afraid to compete. But our government is not allowing us to compete when it tells us that we may no longer use methyl bromide.

But I am a farmer. That is who I am and what I know. If I cannot farm here and make a living, I will farm somewhere—possibly Mexico since the climate and conditions are about the same, and farming is likely to remain a legal and profitable profession.

Mr. Chairman, I thank you for your concern and the opportunity to testify this morning. I would be happy to answer any questions.

Mr. BARTON. We thank you, Mr. Grainger. We would now like to hear from Mr. Miller from California.

TESTIMONY OF CLINT MILLER

Mr. CLINT MILLER. Thank you. Mr. Chairman, my name is Clint Miller. I've grown strawberries in Watsonville, California, for 42 years. I'm here to tell you what will happen to me and to the strawberry industry and to farmers and the employees of many, many other crops if and when methyl bromide is phased out by the year 2001 pursuant to Title VI of the 1990 Clean Air Act Amendments.

We are a family farming operation. We grow strawberries on 250 acres adjacent to the Pajaro River in Watsonville. There are another 250 or so strawberry growers, some larger some smaller in the Salinas-Watsonville area. Unlike most strawberry farmers, we own about half the land we farm. Most lease their land. If we were to lose methyl bromide, three things would happen.

First, the loss would cripple the plant nurseries which grow their young strawberry plants. We plant about 25,000 plants per acre. Methyl bromide fumigation keeps nursery soil free of contaminants: Nematodes, insects, viruses, fungi, weeds, seeds, and other plant diseases.

Without methyl bromide, State agricultural inspectors would have to visually inspect young strawberries plants before they could be shipped to growers. Visual inspection is a very poor substitute for plant inspection and pests would be unavoidably transmitted to farms. We miss the wrong 2 weeks and we've lost an entire year. It's a matter of timing in farming.

Second, our strawberry production would be devastated. Methyl bromide fumigation controls most weeds and allows the roots of our plants to grow large and strong which in turn means that we need far less fertilizer and water and we don't need herbicides.

I have with me examples of two plants, one grown with and one without fumigation. The difference is obvious. Within a couple of years of losing methyl bromide our production of strawberries would decrease by 60 percent. A drop off in production of that magnitude would mean layoffs for my farm. Our farm employs 250 farm workers—

Mr. BARTON. Mr. Miller, it may be obvious to you, but I can't see what you are referring to. Could you hold up the strawberry plants you brought with you? I assume that's the one without methyl bromide soil treatment.

Mr. CLINT MILLER. You got it. And these plants were dug from the test plot with the California Strawberry Commission. Dr. Westerland, the Research Director. These plants were dug on Friday and transported to Washington.

Mr. BARTON. And each of those is one plant.

Mr. CLINT MILLER. Right. Let me point out the difference. You have white roots which live and absorb, pick up the nutrients out of the soil and grow a nice plant, whereas diseased roots just aren't there.

Mr. BARTON. I want you to—remember you're under oath now. Is each of those typical of plants with and without the use of methyl bromide? I mean that one is not an exceptionally bad example of without methyl bromide and one is not an exceptionally good example of with methyl bromide?

Mr. CLINT MILLER. Well, this is like saying, if you don't have disease you won't have a problem. This is in a plot that where there was known disease in the plot which you never know when you're going to plant. That is why you fumigate. This is why we started fumigating back in the 1960's.

When we would get our plants from the nursery without fumigation, the planting stock that came from northern California, as it came down, would already have discolored roots. The way I convinced the people in from our nursery to start fumigating and using methyl bromide was telling them that we wanted to have healthy plants. He says the only difference is you have white roots.

Well, obviously the reason they were white is because they were healthy and they weren't full of disease and when we started getting those we started getting our production up from one crate an

hour to sometimes we get as high as, say, 15 crates per hour where one picker can make 130 to 150 crates in a 10-hour day.

Mr. BARTON. Continue.

Mr. CLINT MILLER. Let's see where I am here now.

Mr. BARTON. We will give you extra time and we will take time anyway from any of the questioning.

Mr. CLINT MILLER. OK. Third, California would lose the strawberry industry to Mexico where methyl bromide will be available after the year 2001. I mentioned earlier that most strawberry growers lease their land and would have little trouble moving all or part of their operation south of the border. Even owning about half of my land, I would give it serious consideration if we lose methyl bromide. I have no choice.

Mr. Chairman, I am sure there are policymakers who believe that we will miraculously find alternatives as soon as we lose methyl bromide. That notion is illogical. We are business people constantly looking for more effective, less expensive ways of doing everything.

I sit on the Research Committee of the California Strawberry Commission. We continue to carefully and thoroughly examine every chemical and nonchemical pest control alternative and technique known to man. If we were to find a safe and effective alternative, we wouldn't wait for the year 2001. We would use it today. But we have found nothing and we are aware of nothing new being developed, tested, or in the regulatory approval pipeline.

I believe I speak for all American farmers when I say that we cannot afford even one more well-intentioned, but misguided government action affecting our farms and the future of our employees.

As I speak, 60,000 cubic yards of dense clay is being removed from 100 acres of my farm which is totally out of production and over 100 jobs lost because government confused its priorities.

In 1947, the Corps of Engineers created the Pajaro Flood Channel to protect our valley. It runs immediately north of our farm. Over the years, the channel filled with sand, trees, roots, grasses, debris, and other matter. We pleaded with the Corps and the county officials to clear the channel. Nothing was done.

In the mid 1980's, the fish and wildlife authorities told us that the channel might—and I emphasize the word "might"—be a habitat for the endangered long-toed salamander. None had ever been seen in the channel.

In March, heavy rains overflowed the Pajaro River and the levee broke due to the diminished capacity causing \$100 million plus damages and loss to our area. Much of the farm was submerged and we lost more than 2.5 million plants.

When we asked for permission to cut through the levee to drain the water back into the Pajaro River, government again was unable to make a decision until the full environmental impact was assessed.

Mr. Chairman, long-toed salamanders are not protected under Title VI of the Clean Air Act, but my story bears direct relevance to this proceeding.

We cannot say that some possible and minimal harm to the environment is more important than clear and lasting damage to our

Nation's ability to produce food. I am not in favor of gutting the Nation's environmental statutes. These laws serve an essential role in a civilized nation, but in the name of the credibility of those laws, a little common sense will go a long way.

I believe to do away with methyl bromide to keep plants and farm soil clean is like not using soap to kill germs when you wash. I thank you for this opportunity and would be pleased to answer questions.

[The prepared statement of Clint Miller follows:]

PREPARED STATEMENT OF CLINT MILLER, CLINT MILLER FARMS, INC., WATSONVILLE, CALIFORNIA

Mr. Chairman, my name is Clint Miller. I have grown strawberries in Watsonville, California, Since 1962 and have been involved in various aspects of strawberry production for more than 40 years. I also farmed strawberries in Oxnard, California for 10 years. I am a member of the Board and past president of Driscoll Strawberry Associates one of the world's largest suppliers of fresh strawberries, blueberries and raspberries. I am also on the Boards of the California Strawberry Commission, Western Growers Association and past member and president of Santa Cruz County Farm Bureau.

I am here to tell you what will happen to me, to the strawberry industry, to the farmers and the employees of many, many other crops, if and when methyl bromide is phased out by the year 2001 pursuant to Chapter VI of the Clean Air Act Amendments.

We are a family farming operation. We grow strawberries on 250 acres adjacent to the Pajaro River in Watsonville. Since we rotate our strawberry production, we are preparing another 250 plus acres at the same time. There are another 250 or so strawberry growers—some larger, some smaller—in the Salinas-Watsonville area.

Unlike most strawberry farmers, we own about half of the land we farm. Most growers lease their farm land.

If we were to lose methyl bromide, three things would happen.

First, the loss would cripple the plant nurseries which grow the young strawberry plants—and we plant about 25,000 plants per acre. Methyl bromide fumigation keeps nursery soil free of contaminants—nematodes, insects, viruses, fungi, weeds seeds and other plant diseases—which can so easily be passed along to individual farms.

Current California Department of Food and Agriculture nursery stock regulations require that ground which grows nursery strawberry stock be fumigated.

Without methyl bromide, state agriculture inspectors would have to visually inspect young strawberry plants before they could be shipped to growers. Visual inspections is a very poor substitute for plant inspection, and pests would unavoidably be transmitted to farms. Farming is a matter of timing—every bit as much as the production of cars, the trading of securities and the management of airlines.

Visual inspection would seriously disrupt our ability to obtain the young plants and use them when Mother Nature is ready for them. An auto manufacturer can miss a few weeks of production and still have a good year. We miss the wrong two weeks, and we've lost an entire year.

Second, our strawberry production would be devastated. Methyl bromide fumigation controls most weeds and allows the roots of our plants to grow large and strong, which in turn means that we need far less fertilizer, water and no herbicides to grow them. I have with me examples of two plants: one grown with, and one without fumigation. The difference is more than obvious.

Within a couple of years of losing methyl bromide, our production of strawberries would decrease by 40-60 percent. (We have fumigated our farm for 30 years and so it would take a while for the pests to regain their hold on our fields) A drop off in production of that magnitude would mean lay-offs for my farm. Our farm employs 250 farm workers, for seven to nine months a year.

I am proud to say that nearly half of our farm workers own their homes and many have children attending college. We provide health insurance and know that they are a major reason why our farm is so productive and efficient. But, more than half of them would not have jobs once we lost methyl bromide.

Third, California would lose its strawberry industry to Mexico, where methyl bromide will be available after the year 2001. I mentioned earlier that most strawberry growers lease their land and would have little trouble moving all or part of their operation south of the border.

Even owning about half my land, I will give it serious consideration if we lose methyl bromide. I would have no choice.

Mr. Chairman, I am sure there are policy makers who believe that we will miraculously find alternatives as soon as we lose methyl bromide. That notion is both insulting and illogical.

We are business people. As such we constantly look for more effective, less expensive ways of doing everything. I sit on the research committee of the California Strawberry Commission. We continue to carefully and thoroughly examine every chemical and non-chemical pest control alternative and technique known to man.

Some alternatives are banned by federal and state authorities. Some—like steam—are laughable to those of us who worry about energy and water conservation. Others—like rotation, compost and cover crops—may make good sense but only work in combination with methyl bromide.

If we were to find a safe and effective alternative, we wouldn't wait for the year 2001. We'd use it today. But, we have found nothing and are aware of nothing new being developed, tested or in the regulatory approval pipeline.

I believe I speak for all American farmers when I say that we cannot afford even one more well-intentioned but misguided government action affecting our farms and the future of our employees.

As I speak, 60,000 cubic yards of dense clay is being removed from 100 plus acres of my farm which is totally out of production and over 100 jobs lost because government confused its priorities.

In 1947, the Corps Engineers created the Pajaro flood channel to protect our valley. It runs immediately north of my farm. Over the years, the channel filled with sand, trees, roots, grasses, debris and other matter. We pleaded with Corps and county officials to clear the channel. Nothing was done!

In the mid 1980's the U.S. Fish and Wildlife authorities told us that the channel might—and I emphasize the word "might" be a habitat for the endangered long-toed salamander. None had ever been seen in the channel. In 1989, the state officials decided that there were no long-toed salamanders in the channel but it wasn't until 1993 that the County was given permission to clear the channel so long as it was done entirely with hand tools, mowers and that no trees over four inches cut down! Very little had been accomplished by this past winter.

In March, heavy rains overflowed the Pajaro River and the levee broke due to diminished capacity due to overgrowth causing \$100 million in property loss to our beautiful Pajaro Valley. Much of my farm was submerged and we lost more than two and one half million plants.

When we asked for permission to cut through the levee to drain the water back into the Pajaro River, government again was unable to make a decision until the full environmental impact was assessed.

Mr. Chairman, long toed salamanders are not protected under Title VI of the Clean Air Act, but my story bears direct relevance to this proceeding.

We cannot say that some possible and minimal harm to the environment is more important than clear and lasting damage to our nation's ability to produce food. I am not in favor of gutting this nation's environmental statutes.

These laws serve an essential role in a civilized nation. But, in the name of the credibility of those laws, a little common sense would go a long way.

I believe to do away with methyl bromide to keep plants and farm soil clean is like not using soap to kill germs when you wash.

I thank you for this opportunity and would be pleased to answer your questions.

NURSERY USE OF METHYL BROMIDE

1. Strawberry plants are grown at the nursery for at least 4 annual generations, with new meristems, and many more generations without meristems, any problem within the plants can be around for many years.

2. These plants are asexually increased geometrically so that any disease or nematode infection that does not outright kill the plant can easily increase from one plant to one million plants in only four years (using conservative increase rates). Therefore a single plant can transmit disease or nematodes to between 30-40 fruiting acres in a normal nursery cycle.

3. Therefore if methyl bromide were not available for nursery use the long term effects of dirty planting stock is much greater than if it were not available for fruiting use. This is because one acre of commercial nursery equals 10-20 acres of fruiting field.

4. However one acre of foundation nursery increase equals 30-40 acres of commercial nursery and from 300 to 800 fruiting acres. It is easy to see how in two years

from foundation to fruiting an unclean nursery field could devastate a large portion of the fruit industry.

5. Methyl bromide is necessary to control water borne soil pathogens like phytophthora species (red stele, etc) that can spread throughout, but not necessarily kill nursery plants. These diseases can be spread to fruiting fields in infected plants, effectively ruining those fields for future strawberry and other crop production.

6. A dormant but serious concern is parasitic nematodes. There is no more effective control than methyl bromide.

7. Current CDFA nursery stock regulations require that ground which grows strawberry nursery either be fumigated with methyl bromide or the plants from every acre be heavily sampled for the presence of nematodes. If this is not done, the plants cannot be harvested and shipped. Currently the State is only able to sample perhaps 5% of the estimated 1500 acres (my estimate?) of strawberry nursery in California. These results are often so late as to delay harvest. They do not have the resources in personnel or labs to process any more.

8. Therefore without methyl bromide after 2001, under the current set of regulations, no nursery stock can be moved within or outside of California. The reason for this regulation is because the State has recognized the value and need for methyl bromide as a nematocide and the disastrous results than can occur to California farm land from the spread of parasitic nematodes through plant transplants. This regulation can be changed, but the threat remains.

9. While there are other concerns such as the increased cost of weed control, the spread of disease and nematodes is the main concern.

10. While the use of methyl bromide is very helpful in fruiting fields, I believe it is absolutely critical at the nursery level. With our present knowledge of and limited success with alternatives to methyl bromide, I do not think the current fruit production system can survive without the continued nursery use of methyl bromide.

Mr. BARTON. Again, I thank the gentleman. The Chair recognizes that the full committee chairman is here, Mr. Bliley. Opening statements have concluded, but if the chairman has a statement, we would be happy to submit it for the record.

Mr. BLILEY. Thank you, Mr. Chairman. We will do just that.

[The prepared statement of Hon. Thomas J. Bliley, Jr. follows:]

PREPARED STATEMENT OF HON. THOMAS J. BLILEY, JR., CHAIRMAN, COMMITTEE ON COMMERCE

I want to thank Chairman Barton for this opportunity to deliver some brief opening remarks.

I know it may be hard to believe, but I was around in the early 1970s when we first heard about the possibility of stratospheric ozone depletion. I was not serving in this body; instead, I was mayor of Richmond, Virginia.

But like most people in this room, I listened to the news and I heard reports that chlorofluorocarbons—or CFCs—could be depleting the stratospheric ozone. This was presented as a new scientific finding with potentially grave consequences.

At that time, one of the prime culprits seemed innocuous enough: underarm spray deodorant. Or, to be more precise, the CFC-laden propellant which was used in those days. It seemed unpalatable at the time, but eventually the United States unilaterally moved to restrict such uses of CFCs.

Other regulatory efforts, lawsuits and scientific filings occurred in the early to mid-1980s. Then, in 1987, the United States joined with 22 other countries to sign the Montreal Protocol calling for a 50% reduction in the consumption of CFCs.

About one year later, EPA was sued by parties who sought a full phaseout of CFCs. This occurred about the time scientists from the 1988 Antarctic expedition reported that the ozone hole was much smaller than in 1987. In 1992, we were informed that an ozone hole might indeed be possible over Kennebunkport, Maine. This event, however, turned out to be a non-event.

I mention this history only to indicate where I believe most people have gained their knowledge of CFCs and ozone depletion. That is, from the news media, in reports which often aim for newspaper headlines or 20 second soundbites. Often, these reports have contained an emotional, if not alarmist warning of the consequences of ozone depletion. Individual reports have also been subject to some inconsistency.

Today, however, I hope that we can engage in a more dispassionate review of the history of CFC and HCFC regulation and the challenges which remain ahead. And,

while the scientific debate is important, our purpose here is to review the implementation of Title VI and the effect of the 1990 Clean Air Act Amendments.

Thus, I will be most interested in the review of regulatory actions affecting CFCs and HCFCs. In addition, since there has been a close interaction between the 1990 Amendments and the Montreal Protocol process, I believe this subcommittee should examine the precise position of the United States prior to the planned fall session of the Parties to the Protocol.

We also need to be aware of the full impact of our policies on the average consumer. Like many Members of Congress, I have heard from my constituents back home who wonder, sometimes loudly, about the effects of a full CFC phaseout on January 1, 1996.

Again, I want to thank Mr. Barton for his attention to this most important area of the 1990 Amendments. I believe the subcommittee's work to date has been very productive and I am certain today's hearing will be equally helpful in our ongoing review of the Clean Air Act.

Mr. BARTON. The Chair would now recognize Mr. Dennis Rochford and indicate that Mr. Jim Greenwood of this subcommittee is his Congressman. Mr. Greenwood is in a hearing on Medicaid or he would be here to introduce you.

Mr. Rochford.

TESTIMONY OF DENNIS ROCHFORD

Mr. ROCHFORD. Thank you very much, Mr. Chairman. My name is Dennis Rochford. I am President of the Maritime Exchange for the Delaware River and Bay.

In effect, we operate as a Chamber of Commerce of the Delaware River. We represent over 250 port-related businesses and that encompasses port activities in south New Jersey, southeastern Pennsylvania and the State of Delaware.

The ports of Philadelphia along that river corridor handle approximately 3,000 cargo vessels per year, over 65 million tons of general and bulk cargo, and it generates over four billion dollars to the regional economy. Chilean fruit is one of our key cargos. It comes into our ports to serve consumer markets throughout the Northeast. It is also a key cargo for California, Florida, and North Carolina.

I would like to make the point that the Maritime Exchange effectively functions as an interface between port businesses and government agencies: Primarily the Coast Guard, the Customs Service, USDA, FDA and other Federal agencies.

An example of what we do, not particularly relevant to this hearing, but how we function, along with the State of Delaware, we have established a sensitive cargo tracking system on the Delaware River to track the movement of all tankers and oil barges and in the event of an oil spill or casualty. We're tied into the Coast Guard so they can respond instantaneously. I make this point to show that the Maritime Exchange, even though it's a trade association representing port businesses, has a vested interest not only in our economy but also in protecting the environment.

The loss of methyl bromide to the port industry in Philadelphia and I would argue around this country is not a simple matter, but of significant consequence. Chilean fruit is a key cargo as I pointed out not only on our river, but for our country. And in terms of the global economy within which we must compete, this aspect of international trade is important and any decision that's made that's disruptive to that has obviously economic overtones.

Methyl bromide is applied in a gaseous form as a fumigant for Chilean cargo that comes into the United States, the purpose of which to destroy insects, rodents, bacteria, other elements that would contaminate that fruit. We are aware of the fact that industry has worked to try to identify viable alternatives to methyl bromide and many of the members of this panel have already alluded to that. But the fact of the matter is, as the Congressman from Florida pointed out, we're sort of in a Catch-22 situation here.

If the United States is the only country that's going to ban methyl bromide in the year 2001, and Mexico and Chile and other countries around the world are not going to do that, we're going to put a very key aspect of our international trade at risk and it will have overtones not only for our economy but for the consumers of this country.

So we would urge this panel to give serious consideration to not eliminate methyl bromide by the year 2001 until a suitable alternative has been identified and tested in the marketplace. It is my understanding that to bring an alternative to line in the marketplace can take up to and perhaps exceed a 10-year testing and registration period.

It would be prudent, I believe, from an international trade point of view and from a port's perspective, that that alternative has to be tested and in the marketplace before we allow ourselves to be compelled by a deadline of 2001. This might be what's on the plate now, but I believe would be disadvantageous to our economy. Thank you.

[The prepared statement of Dennis Rochford follows:]

PREPARED STATEMENT OF DENNIS ROCHFORD, PRESIDENT, MARITIME EXCHANGE FOR THE DELAWARE RIVER AND BAY

Mr. Chairman: My name is Dennis Rochford, and I am President of the Maritime Exchange for the Delaware River and Bay.

Our organization was established in 1875 and currently represents over 200 port and related businesses throughout the Delaware Valley region. These include steamship agents and operators, stevedores, marine terminal and warehouse operators, ship and harbor service companies, customs brokers, freight forwarders, inland transporters and many other businesses, organizations and individuals concerned with the Delaware River ports. Our reporting area extends from the mouth of the Delaware Bay through Trenton—encompassing Delaware, Southern New Jersey, Philadelphia and suburban port facilities.

Together, our ports handle more than 65 million tons of international, waterborne cargo annually. This commerce generates more than \$4 billion to our tri-state regional economy.

In addition to representing the interests of our members, the Maritime Exchange plays a critical role in ensuring the safety of the more than 2,700 ships which transit the Delaware River each year. Our Sensitive Cargo Tracking system—which interfaces with the United States Coast Guard operations center in Philadelphia provides instantaneous access to critical information needed by those who respond to oil and chemical spills and related accidents.

Clearly, the Maritime Exchange and its membership have a vested interest in protecting both the economic and the ecologic viabilities of our tri-state region. We live here as well as work here.

I am here today to talk about the potential loss of methyl bromide by the year 2001 and its impact on the regional port. This is not a simple matter. Title VI of the Clean Air Act is but one law our members must obey, and ozone protection is but one element of public health and safety.

Our national policy speaks to the need to encourage trade with other nations for the precise purpose of creating decent paying jobs for Americans, and greater choice for consumers.

Federal laws also exist to protect our nation's citizens from unfair trade practices, imports of illegal substances as well as pests destructive to U.S. agriculture and many other public health and safety threats. We regard the United States Department of Agriculture's Animal and Plant Health Inspection Service, the Food and Drug Administration, the Coast Guard and U.S. Customs Service as partners of private industry in this important process.

Among the various procedures which must be followed to ensure both business and government needs are met includes cargo fumigation with methyl bromide. Methyl bromide allows our members, their customers—and ultimately those millions of consumers who buy fruit and vegetable products—to protect U.S. agriculture from destructive pests and to meet the strict safety and health standards imposed by federal law.

Our members have been looking for alternatives, for more cost-effective ways of complying with these statutes. They were doing so before the Clean Air Act Amendments were passed and, as prudent and responsible businesses, they will continue to do so. We have looked at irradiation, other chemicals, heat treatments and other technologies. However, these are simply not practical or feasible, and as a result, there are no approved alternatives to methyl bromide suitable for our purposes today.

The bottom line is: there are no acceptable alternatives which will permit us to obey food safety and plant protection laws, and there are none on the immediate scientific horizon.

We are fortunate to have methyl bromide as our one and only option at this time. This one fumigant protects against the insects, rodents, bacteria and plant diseases we must control.

To illustrate the importance of methyl bromide to the people of our region, permit me to use the example of the 35 million crates of Chilean fruit received by our ports each year. I must note that Chilean fruit also enters ports in Florida, North Carolina, California and other American cities, and is a significant source of the fresh fruit Americans need and enjoy in the winter months. We will follow the progress of the cargo carried by a single ship containing Chilean fruit.

As this ship enters the Delaware Bay, it is met by tugboat operators which escort the ship to its berth. On board may be as many as 6,000 pallets of highly perishable, fresh fruit—enough to fill more than two football fields. In order to preserve this valuable cargo, from this point forward, it must be handled quickly and with expertise to move it as fast as possible to get it to the consumer and make room for the next vessel load following right behind it.

Longshoremen unload the cargo, warehousemen arrange the cargo into sorted loads for each U.S. importing company with cargo on board. There may be as many as 35 importers per vessel.

Then, USDA, FDA, Customs and Coast Guard officials inspect the vessel and cargo. This is the point at which the fruit is fumigated—by highly-trained technicians under tightly-controlled circumstances and fully supervised by USDA—with methyl bromide.

After fumigation and once cleared by USDA, FDA and Customs, private fruit inspectors and graders descend on the terminal. Expeditors, fruit importers, buyers and brokers then decide which shipments go to various markets. As many as 300 truckers are then required to move the fruit to cold storage warehouses, terminal markets, distribution centers, supermarkets and food processing operations.

Virtually thousands of New Jersey, Pennsylvania and Delaware residents are employed as a direct result of our role in receiving Chilean fruit. And I hasten to add that our ports also handle a wide variety of other crops: pineapples and melons from Central America, cocoa beans from the Caribbean and Ivory Coast, apples from Brazil, and the export of American logs, just to name a few. All are dependent on methyl bromide.

To do their important job—and to do it in the full public interest—our port operators need methyl bromide at least until safe and effective alternatives are commercially available and fully approved.

To deny us the use of this product means denying our region's consumers an important element of their diet. It means denying our region a significant source of jobs and revenue.

Thank you for this opportunity to testify. I would be happy to answer any questions the Committee might have.

Mr. BARTON. Thank you, Mr. Rochford. We will now hear from Mr. Steve Ziller, who is representing the Grocery Manufacturers of America.

TESTIMONY OF STEPHEN A. ZILLER

Mr. ZILLER. Thank you, Mr. Chairman. I'm Steve Ziller, the Vice President of Scientific and Technical Affairs for the Grocery Manufacturers of America. GMA is an organization representing food manufacturers with sales of \$360 billion, which represents 85 percent of all the food and consumer package goods sold in the United States.

The U.S. food industry employs the most effective sanitation measures to help ensure their brands maintain the highest confidence of their consumers worldwide. One of the unique tools to help achieve freedom from insects and pests is the use of the fumigant, methyl bromide.

Mr. Chairman, the critical nature of preserving methyl bromide for food manufacturers has been so great that they have put their money where their mouth is. In an unprecedented action, the food industry has spent about a million dollars adding to the safety data base of methyl bromide for its reregistration and for tolerance for the use of methyl bromide in a wide variety of important food crops, food ingredients and packaged food products.

An industry that has undergone drastic downsizing and reduction of costs would not be spending this kind of money if there were other cost-effective measures available.

Today the focus is on the impact of substances on stratospheric ozone depletion. We note that is an area where there appears to be significant continuing uncertainty about the science behind the methyl bromide restrictions and bans and I'm pleased to hear there will be two eminent scientists to present the case about these uncertainties after this panel.

Some estimates consider that all the uses of methyl bromide may account for only about 5 percent of the overall effect on the ozone layer. In fact, recent studies suggest that methyl bromide may act to buffer the effects of other ozone depleters, thus ameliorating their adverse effects.

We need to be sure we do not rush into a hasty conclusion which we will regret if less effective alternatives are forced upon us before demonstrating their technical effectiveness and commercial viability. In addition, requirements of the Montreal Protocol should apply equally to all countries which signed the treaty. No unilateral position should endure which puts U.S. agriculture and the food industry at a competitive disadvantage.

The food manufacturing industry has participated in evaluating a host of substitutes and combinations of strategies to attempt to minimize essential uses of methyl bromide. They have also worked with the United States Department of Agriculture to make sure that work there is developed with the direction of the affected industry.

Methyl bromide has been the fumigant of choice for a number of unique uses. Methyl bromide has significant advantages in its economics of use and low cost, its quick treatment time, usually only a day under the conditions that I'm describing, and its high effectiveness because of its unique penetration and pest kill capabilities.

Alternatives currently being evaluated can take from three to 15 days versus the 1 day of methyl bromide treatment. Closing a plant or a warehouse for many days during a year to carry out fumiga-

tions may have a large impact on lost sales or the need of opening additional plants or warehouses to meet demand.

One of the real alternatives that is used frequently in applications is the use of phosphine. It is more costly. It takes two or three times longer to apply than methyl bromide and it has limitations when the temperatures are below 50 degrees. But most importantly, phosphine has a highly corrosive effect on high tech controllers and communication equipment frequently found in manufacturing plants and warehouses.

Inert gases alone or in combination with other alternative fumigants can also be used in certain applications, but they have a high cost, they are very slow needing many days for application, and they require that the facility be tight enough to maintain the required concentration of gases during the treatment in order to become effective.

A nonchemical method, heat, has drawn a lot of interest and may work well for certain types of facilities where buildings are tight enough not to lose the heat too fast. This technique is extremely capital-intensive, still takes days to be effective and requires temperatures of 120 to 140 degrees that can negatively impact on buildings, mechanical equipment, heat sensors and other factors that are susceptible to the heat.

Finally, one needs to be aware that any new chemical discovered for use as a methyl bromide alternative would have to undergo years of safety testing and regulatory approval before being commercially available.

In summary, then, the food manufacturing industry has critical needs for methyl bromide as an insecticide. There are no safe cost-effective and commercially viable alternatives for all these uses. The industry and government is working hard to minimize methyl bromide use to find suitable alternatives now.

Congress should not allow EPA to ban critical uses until more acceptable alternatives are available. The Clean Air Act should be amended to reflect a justified need. Thank you for the opportunity to testify. I'll be happy to answer any questions.

[The prepared statement of Stephen A. Ziller follows:]

PREPARED STATEMENT OF STEPHEN A. ZILLER, PH.D., VICE PRESIDENT, SCIENTIFIC AND TECHNICAL AFFAIRS, GROCERY MANUFACTURERS OF AMERICA, INC.

Mr. Chairman, I am Dr. Steve Ziller, Vice President, Scientific and Technical Affairs, for the Grocery Manufacturers of America, Inc. (GMA). GMA is an organization representing companies that make and market the world's best-known brands of food and consumer packaged goods. GMA is the industry voice on public policy and industry productivity issues, through strategic issues management involving government relations, communications, legal, regulatory, scientific and education advocacy. GMA member companies have sales of 360 billion dollars and represent the largest volume (85%) of all food and consumer packaged goods sold in the U.S.

GMA companies and those of our many sister trade associations representing the U.S. food manufacturing community produce the safest and highest quality foods in the world. These companies employ the most effective sanitation procedures to help ensure their brands maintain the highest confidence of the American consumers. One of the unique tools to help achieve freedom from insects, rodents, and other pests is the use of the fumigant, methyl bromide. Critical applications go back to the agricultural practices where foods are grown and continue down the food chain through stages of raw materials, silo storage and food manufacturing facilities, transportation vehicles, and finished product warehouses. The food industry needs relief from some unilateral aspects of the Montreal Protocol and from the EPA restrictions and ban on methyl bromide uses for critical food industry needs.

Mr. Chairman, the critical nature of preserving methyl bromide for food manufacturers has been so great that they have "put their money where their mouth is." In an unprecedented action, the food industry has spent about a million dollars adding to the safety database for methyl bromide reregistration and providing specific residue data to EPA via the registrants in order to establish appropriate tolerances for use of methyl bromide in a wide variety of important food crops, food ingredients, and packaged food products. The important process of gathering and submitting the data for reregistration and tolerance setting is nearly complete.

GMA has been a participant in developing this new safety data for submission to EPA. We have been involved with a broad industry effort to carry out a long term animal feeding study with methyl bromide. This study will cost about \$330,000 to carry out. The final report is expected to be completed and submitted to EPA this December. In addition, GMA member companies have funded two residue studies on representative packaged foods in order to gain a general food tolerance for mixed foods in food distribution warehouses where methyl bromide fumigation is required for insect control. The two residue studies will cost about \$200,000 total. An industry that has undergone drastic downsizing and reduction of costs would not be spending this kind of money if there were acceptable alternatives.

Our conclusion is that methyl bromide is safe when applied properly in both food contact uses or in fumigation of food manufacturing facilities and transport vehicles. Methyl bromide has significant advantages in its economics of use (low cost), quick treatment time (usually only a day), and high effectiveness (unique penetration and pest kill).

Today the focus is on the impact of substances on stratospheric ozone depletion. We note that in this area there appears to be significant continuing uncertainty about the science behind the methyl bromide restrictions and ban. As more careful examination has been made the estimated impact of methyl bromide on the ozone layer has decreased. This committee should understand that methyl bromide is the only naturally occurring class one ozone depletor and that most of the methyl bromide produced annually is a by-product of metabolism in marine and estuarine environments. Methyl bromide phaseout will not change this.

Some estimates consider that all uses of methyl bromide may account for only about 5% of the overall effects on the ozone layer. In fact, recent studies suggest that methyl bromide may act to buffer the effects of other ozone depletors, thus ameliorating their adverse effects. Thus we need to be sure we do not rush to a hasty conclusion which we will regret if less effective alternatives are forced upon us before demonstrating their technical effectiveness and commercial viability. In addition, requirements of the Montreal Protocol should apply equally to all countries which signed the treaty. No unilateral position should endure which puts U.S. agriculture and food industry at a competitive disadvantage.

While the food manufacturing industry believes that there are no safe, cost effective, and commercially proven alternatives available for all their needs, they have participated in evaluating a host of substitutes and combinations of strategies to attempt to minimize essential uses of methyl bromide. They have also worked with the United States Department of Agriculture to make sure that work there to develop alternatives has the best direction from the affected industry.

Methyl bromide has been the fumigant of choice for a number of unique uses that involve fumigation of some critical raw materials, fumigation of processing facilities which are particularly attractive to insect infestation, fumigation of processed and packaged food warehouses, and fumigation of food transport vehicles. The time a plant is closed during its application is the shortest, usually a day or so. This fits very well with plants where fumigation can be done over weekends. Alternatives currently being evaluated can take from 3 to 15 days depending on the conditions.

The time advantage translates into major costs if methyl bromide is lost for such uses. Downsizing of companies have resulted in closing many plants and utilizing the remaining ones at high levels of output. Taking a plant or a warehouse out of play for many days during a year to carry out fumigations with alternative procedures may have a large impact on lost sales or the need for opening additional plants or warehouses to meet demand. Thus, there is more than a direct fumigant cost comparison needed.

One of the real alternatives that is used frequently in certain applications is the use of phosphine. It is more costly, takes 2-3 times longer to apply than methyl bromide, and has limitations when temperatures are below 50 degrees. But most importantly, phosphine has a highly corrosive effect on high-tech controllers and communications equipment frequently found in manufacturing plants and warehouses. This very good fumigant simply cannot replace methyl bromide in all its unique features that are essential to the food industry.

Inert gases alone or in combination with other alternate fumigants can be used in certain applications but they have a high cost, they are very slow (many days), and they require that the facility be "tight" enough to maintain the required concentration of gasses during the treatment to be effective.

A non-chemical method, heat has drawn a lot of interest and may work well for certain types of facilities where buildings are tight enough not to lose heat too fast. This technique is extremely capital intensive, still takes many days to be effective, and requires temperatures of 120-140 degrees which can negatively impact the building, mechanical equipment, and heat sensors.

Finally, one needs to be aware that any new chemical discovered for use as a methyl bromide alternative would have to undergo years of safety testing and regulatory approval before being commercially available.

In summary, the food manufacturing industry has critical needs for methyl bromide as an insecticide. There are no safe, cost-effective, and commercially viable alternatives. The industry and government is working hard to minimize methyl bromide use and find suitable alternatives now. Congress should not allow EPA to ban critical uses until more acceptable alternatives are available. The Clean Air Act should be amended to reflect this justified need.

Thank you for the opportunity to testify today. I would be happy to answer any questions you may have.

Mr. BARTON. Thank you, Mr. Ziller. The Chair now recognizes Mr. Tom Pavich of Pavich Family Farms in California.

TESTIMONY OF TOM PAVICH

Mr. PAVICH. Thank you, Mr. Chairman. My name is Tom Pavich of Pavich Family Farms in Terra Bella, California.

Thank you for the opportunity to testify before this distinguished committee.

I'm here today to specifically discuss methyl bromide and alternatives to its use. Before I do, I'd like to tell you a little bit about our farm.

Pavich Family Farms has been in business for the last 42 years. Today, we farm over 3,000 acres of table grapes and raisin grapes in California and Arizona which represents approximately 2 percent of the Nation's table grapes. For the past 24 years, we have produced these grapes using certified organic methods. We also recently expanded into the raisin business and produce about a thousand tons of organic raisins each year.

For many years we have chosen to farm organically. In fact, we use organic production practices on 90 percent of our acreage, even though we don't always sell our grapes as organic. We currently sell about one third of our crop as organic, which is all the market can currently bear. The rest is sold as conventional. At Pavich Family Farms, we have successfully eliminated the use of methyl bromide in some parts of our operation, but not in all of them.

We have found that for raisins cold storage works just as well as methyl bromide in terms of preventing pest infestations. Cold storage is more expensive than methyl bromide, but it is an effective alternative.

At this point, we still use methyl bromide as a preplant fumigant prior to replanting our grapevines. This is about a 30-year cycle. Because of our extensive soil-building program that we developed, we feel that we will be able to reduce the frequency of methyl bromide applications by about one third.

We believe that building the health of our soil will extend the lifetime of our vineyard by about as much as 10 years reducing the need to replant with new vines as often, thus reducing the frequency of methyl bromide treatments.

We build the health of our soil by fallowing and planting cover crops for at least 3 years prior to planting to interrupt the reproductive cycle of soil pests. Once the vineyard is established, we plant cover crops between the vine rows to fix nitrogen and improve the tilth of the soil and apply organic matter, minerals, and beneficial microbes.

Sometimes under certain soil conditions and soil types, we have found that soil pest populations have been high according to University of California standards, but the plants are still healthy and produce high yields. We are just beginning to experiment with alternatives to methyl bromide.

As organic growers, we prefer to use the safest and most natural pest control methods so our first choice would not be methyl bromide. Right now, however, we haven't found a replacement for fumigation in replant situations that is as economically viable as methyl bromide, so we do continue to use it.

Next year, we are going to be experimenting on one or two acres with about 15 different techniques. Of course, any time you experiment with new alternatives, they don't always work right away. I hope that over time and before the 2001 phaseout date that these alternatives will work for us. I hope that our business will manage without methyl bromide. But I know that that won't be easy.

We would support the ban on methyl bromide if there were and only if there were scientifically proven alternatives. Right now we have an alternative for commodity storage that works extremely well and we have proven to ourselves that it works as well as methyl bromide, but we aren't there yet with soil fumigation. And I believe a number of things must happen if we and all agriculture are going to meet this goal.

First, we need to redirect existing resources within the land grant university system to focus on research that takes place on the farm. Too much research takes place under laboratory conditions and has little relevance to farmers' real needs.

Second, this research must take a whole systems and not a piecemeal approach to figuring out ways to manage pest problems without fumigation. This means paying particular attention to soil and plant health. For example, developing varieties of root stock that are resistant to soil pests, but that also produce high quality fruit. We are currently involved in a university research trial using resistant root stock and I hope that we do find that it works.

Third, I believe we need more support for nonprofit research organizations that are far more tuned in to farmers' needs than the USDA. I am on the board of the Organic Farming Research Foundation, a private nonprofit research foundation dedicated to on-farm organic research.

I believe with our very small average annual budget of \$100,000, in which we have funded 48 separate grants to organic farmers, we have done more to find alternatives to pesticides and to develop organic farming techniques than the millions of dollars that have been spent by USDA.

Fourth, it is imperative that the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation ensure the rapid registration of safer nontoxic alternatives to methyl bromide.

For example, we are starting to experiment with the use of sesame stock as a soil amendment to control nematodes. Nematodes are the microscopic worms that destroy grape vines and grape roots and normally are controlled by methyl bromide. The sesame plant is the same plant that gives us sesame seeds for our burger buns. It took 7 years to register sesame stock as a natural pesticide because of bureaucracy and red tape.

The USDA and EPA need to have a coordinated and intensive strategy to help growers phaseout the use of methyl bromide. As long as they implement such a strategy we can avoid a crisis down the road. The agricultural industry can someday survive without the use of methyl bromide, but it is going to take a serious research and technology transfer effort to make sure this change is not too costly.

If all farmers lose methyl bromide and there are viable alternatives, then no one farmer will experience too much loss because we will all be on a level playing field. This means we need to extend the ban on methyl bromide to other countries.

I imagine that the loss of methyl bromide will force grape producers and other commodities that currently rely on methyl bromide to diversify their operations, develop more effective systems for rotating crops and preventing the buildup of pest problems. In the end, this will foster innovation and diversity, two principles of sound business practice that I adhere to as much as possible.

I brought along some of our raisins to demonstrate the successful use of an alternative to methyl bromide. Please allow for the research that is necessary to develop alternatives for other crops. Again, thank you for your opportunity to testify today and I welcome any questions and any other comments you may have.

[The prepared statement of Tom Pavich follows:]

PREPARED STATEMENT OF TOM PAVICH, PAVICH FAMILY FARMS

Hello, Mr. Chairman, my name is Tom Pavich of Pavich Family Farms in Terra Bella, California. Thank you for the opportunity to testify before this distinguished committee.

I am here today to specifically discuss methyl bromide and alternatives to its use. Before I do, I would like to tell you about our family farm.

Pavich Family Farms has been in business for the past 42 years. Today, we farm 3,000 acres of table and raisin grapes in California and Arizona, which represents approximately 2 percent of the nation's table grapes. For the past 24 years, we have produced these grapes using certified organic methods. We also recently expanded into the raisin business and produce about 1,000 tons every year.

For many years, we have chosen to farm organically. In fact, we use organic production practices on 90 percent of our acreage even though we don't always sell our grapes as organic. We sell about one-third of our crop as organic which is all the market can currently bear. The rest is sold as conventional.

At Pavich Family Farms, we have successfully eliminated the use of methyl bromide in some parts of our operation but not in all of them. We have found that for raisins, cold storage works just as well as methyl bromide in terms of preventing pest infestations. Cold storage is more expensive than methyl bromide but it is an effective alternative.

At this point, we still use methyl bromide as a preplant fumigant prior to replanting our grape vines. This is about a 30 year cycle. Because of our extensive soil-building program, we feel that we will be able to reduce the frequency of methyl bromide applications by about one-third. We believe that building the health of the soil will extend the lifetime of our vineyard by as much as ten years, thereby reducing the need to replant with new vines as often, thus reducing the frequency of methyl bromide treatments.

We build the health of our soil by fallowing and planting cover crops for at least three years prior to planting to interrupt the reproductive cycle of pests. Once the

vineyard is established, we plant cover crops between vine rows to fix nitrogen and improve the tilth of the soil and apply organic matter, minerals and beneficial microbes. Sometimes, under the right conditions and soil types, we have found that soil pest populations have been high, according to University of California standards, but that the plants are still healthy and produce high yields.

We are just beginning to experiment with alternatives to methyl bromide. As organic growers, we prefer to use the safest and most natural pest control methods so our first choice would not be methyl bromide. Right now, however, we haven't found a replacement for fumigation in replant situations that is as economically viable as methyl bromide. Next year, we are going to begin experimenting on one or two acres with about 15 different techniques. Of course, any time you experiment with new alternatives they don't always work right away. I hope that over time and before the 2001 phase-out date that these alternatives will work for us. I hope that our business will manage without methyl bromide.

But I know that it won't be easy. We would support the ban on methyl bromide if there were scientifically proven alternatives. Right now, we have an alternative for commodity storage that works extremely well and we have proven to ourselves that it works as well as methyl bromide. But we aren't there yet with soil fumigation and I believe a number of things must happen if we, and all of agriculture, are going to meet this goal.

First, we need to redirect existing resources within the land grant University system to focus on research that takes place on the farm. Too much research takes place under laboratory conditions and has little relevance to farmers' real needs.

Second, this research must take a whole-systems, not a piece-meal, approach to figuring out ways to manage pest problems without fumigation. This means paying particular attention to soil health. For example, developing varieties of rootstock that are resistant to soil pests but that also produce high quality fruit. We are currently involved in a University research trial using more resistant rootstock and I hope that we find it works.

Third, I believe we need more support for non-profit research organizations that are more tuned-in to farmers' needs than the U.S. Department of Agriculture (USDA). I am on the Board of the Organic Farming Research Foundation (OFRF) and I believe that with our very small annual budget of \$100,000, we have done more to find alternatives to pesticides and to develop organic farming techniques than millions of dollars at the USDA.

Fourth, it is imperative that the U.S. Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation (CDPR) ensure the rapid registration of safer alternatives to methyl bromide. For example, we are starting to experiment with the use of sesame stalk as a soil amendment to control nematodes. Nematodes are the microscopic worms that can destroy grape vines and that are normally controlled by methyl bromide. It took seven years to register sesame stalk as a natural pesticide because of bureaucracy and red tape. The USDA and EPA need to have a coordinated and intensive strategy to help growers phaseout the use of methyl bromide. As long as they implement such a strategy, we can avoid a crisis down the road.

The agriculture industry can someday survive without the use of methyl bromide but it is going to take a serious research and technology transfer effort to make sure this change is not too costly. If all farmers lose methyl bromide and there are viable alternatives, then no one farmer will experience too much loss because we will all be on a level playing field. But this means we need to extend the ban on methyl bromide to other countries.

I imagine that the loss of methyl bromide will force grape producers and other commodities that currently rely on methyl bromide to diversify their operations, to develop more effective systems for rotating crops and preventing the build-up of pest problems. In the end, this will foster innovation and diversity, two principles of sound business practice that I adhere to as much as possible.

Again, thank you for the opportunity to testify today and I welcome any questions that you and other committee members may have.

Mr. BARTON. Thank you, Mr. Pavich. The Chair would indicate that the distinguished ranking member, Mr. Dingell, is here. His opening statement, if any, will be submitted for the record.

Mr. DINGELL. All I would like to do is welcome Mr. Pavich and tell him we are delighted he is here with us this morning. Thank you.

Mr. BARTON. Thank you.

Since I interrupted Mr. Miller and asked a question during his testimony, I will just ask one question and then recognize Mr. Wyden. Mr. Grainger and Mr. Miller you've heard Mr. Pavich indicate that at least in the vineyard business, organic farming may be a substitute for most cases where you might use methyl bromide.

Could you gentlemen comment on his style of farming for the tomato industry and the strawberry industry and if you could do the same thing that he has done in the grape growing business.

Mr. GRAINGER. Organic farming in the State of Florida, if that's the question, I think it'd be hard to compare what the gentleman is doing in California, because we have humid weather and I'm not aware of any organic farming going on in the State of Florida. If there is so, like I said, I'm not aware of it.

Mr. BARTON. Is there a difference between—the basic question is, is there something about growing grapes that lends itself to organic methods that you could not use such methods in tomatoes and strawberries?

Mr. GRAINGER. I'm sure there is, but I don't know the answer to that question. But I would be certainly glad to get you a response to it.

Mr. BARTON. Mr. Miller.

Mr. CLINT MILLER. Yes, we can grow organically. The problem is in extra cost and, as I stated earlier, the amount of productivity for the employees. On our farm we start at \$6.75 an hour and there is just no way that we can produce off of plants that are organically grown at this time.

I belong to several organizations and we have been testing for years, and years, and years and I have grown organically, but organic right now is not cost-effective and as Tom said, there's a limited market to what you can produce out there as to what you can sell and get paid for. You know, you can give things away, but it's not always easy to collect and the crops that we grow are beautiful commercial things that you would select in the store and the organic was not really that way. It's possible.

Mr. BARTON. Mr. Rochford, briefly, what's the likelihood of foreign nations phasing out methyl bromide? Again, Mr. Pavich had indicated we needed to do that. Do you think Mexico would voluntarily restrict the use of methyl bromide in their nation?

Mr. ROCHFORD. I'm only familiar with what I have read. I'm not an expert in that area. But everything I read and the conversations that I have with people in the trade, indicate that Mexico and Chile, are at least not positioned today along with a lot of other developing countries to phaseout methyl bromide because they see it as important to an industry in their country that's important to their economy.

One of the other points very quickly worth making is that if Chilean fruit coming into this country can no longer come into this country because we don't have methyl bromide to fumigate it, the alternative for the growers is to find other markets in Europe and Eastern Europe and Asia. So we ought not to think that one way or the other that the fruit is necessarily going to come here.

Mr. BARTON. Mr. Wyden.

Mr. WYDEN. Thank you, Mr. Chairman. I want to thank the panel for a lot of very thoughtful analysis. I come to this issue, Ms.

Furse and I have a corner of the world where we have got a lot of growers, a nursery sector that we are very proud of. We have got the problem of having to fumigate imported logs with methyl bromide. We have a lot of agricultural interests and, at the same time, it is very clear that the history of this act does indicate that markets can work and markets can work when you set deadlines and really push for alternatives. That is what happened in the case of the CFCs and halons and some other areas.

Now, you haven't seen it, but the Administrator of the Environmental Protection Agency says in her testimony that she believes that there ought to be a safety valve to ensure that methyl bromide users aren't left in the lurch if alternatives aren't available by 2001, and that EPA will seek an appropriate remedy if this turns out to be the worst-case scenario that has been mentioned.

My question, and I think it might be appropriate for Mr. Grainger and Mr. Miller, that the two of you gentlemen answer. If EPA takes this position that there ought to be a safety valve, wouldn't that address many of the legitimate concerns that you all are raising this morning?

Mr. CLINT MILLER. Well, from my standpoint that would be necessary. I mean, at this point, we cannot see how we can produce cost-effectively without it. And I've only talked about the growing aspect of it. There is also the part of post-treatment, which is the same as Mr. Rochford is experience. We do a lot of post-treatment for export and export helps the GNP so you know that we would be affected there, also.

I'm here to try to get across to you that I've been doing this for 40 years, I saw methyl bromide start. I worked with Dr. Wilhelm at the University of California pathology department when we started this and before that we were like gypsies. We moved around growing strawberries. We moved from area to area. We would try to find ground where there were no strawberries planted for at least 25 years and then move into another area.

You, being from a nursery operation and familiar with that, would realize that maybe you could grow the crop that way, but growing at nurseries and trying to find clean ground, you know, is just—it's really tough.

We'd be happy to use any alternative, work with the Crop Production Coalition, the Strawberry Commission. We have acres in the millions right now. We have over a three-million-dollar budget in the Strawberry Commission, working with the Crop Protection Commission and we're working to find an alternative. We want to find it.

It costs me \$1,500 an acre to fumigate with methyl bromide and I would like not to do it, but it is cost-effective. It's what keeps us in business and our industry in business, which is an over \$500 million industry, strawberries in California.

Mr. WYDEN. Mr. Grainger, what do you think? If EPA is willing to take this position, would this respond in a significant way to your concern?

Mr. GRAINGER. Yes, it would be very helpful to us. Like Mr. Miller said, back when I was a kid, my grandfather and father, they would move around to various lands and farm new land back before there was methyl bromide, but because of development and

land availability, it's hard to rotate your crops and land is very limited because farmland is very limited.

I also am a member of the Florida Tomato Committee and I'm not aware of the actual numbers we're spending to look at alternatives and support groups that are working on an alternative for methyl bromide, but as a member of the Florida Tomato Committee and representing the State of Florida and myself and family, if there's something out there that will work and will keep us in the same playing field as methyl bromide, we would certainly make a transition.

Mr. WYDEN. Let me see real quickly if I can get you, Mr. Grainger, and you, Mr. Rochford, into what I think also is part of this debate and seems to be taking it in different directions.

Now, Mr. Grainger, you said in your testimony that when methyl bromide is phased out, U.S. growers wouldn't be able to compete with tomatoes from Mexico that will continue to be grown with methyl bromide.

Now, Mr. Rochford, it seems to me, says that without methyl bromide importers won't be able to fumigate to meet U.S. food protection standards which would mean that produce couldn't come into the country. So how do we reconcile these two positions? We've got people, it seems to me, that are at odds with each other. Would you comment?

Mr. ROCHFORD. The only comment I have with respect to the importation of fruit is that there are laws on the book, USDA laws on the book in terms of allowing perishable commodities to come into this country. If perishable commodities are not fumigated and meet the standards and when, in fact, they are fumigated in a port, there is, in fact, a USDA or FDA representative to test that cargo before it is turned over to the importers. So it seems to me as a matter of law without methyl bromide or an alternative to that that would satisfy the requirements, again of the FDA and the USDA, that we just couldn't import that cargo. The point I was trying to make is we went through this last year in the vessel tonnage tax.

One of the things that was clear to me—we have the largest banana port in the country in Wilmington, Delaware, and the exporters are out of Central America—rather than pay the tens if not hundreds of thousands of dollars that that tax would have meant to them, exporters would have shifted their exports to Africa or Europe.

Mr. WYDEN. I guess what concerns me is that you have essentially said that Delaware ports are going to be shut down because foreign produce won't be allowed in the United States.

Mr. Grainger says that U.S. growers could be put out of business by foreign competition. And somehow I think we've got to try to reconcile this, but my time is up.

Mr. ROCHFORD. At least for the record I don't think I've suggested that if we lose Chilean fruit that the ports along the Delaware River and bay are going to be shut down, but it is, in fact, a significant cargo and would have a measurable impact on the trade on that river.

Mr. BARTON. The gentleman has asked a very pertinent question which we need to find the legality of. The Chair wants to announce

that Members are recognized by order of appearance with the exception of the ranking member and the chairman and ranking member of the full committee, so the Chair would now recognize Mr. Burr of North Carolina. The Members that are here visiting that are not members of the subcommittee will be allowed to ask questions, but only after the members of the subcommittee have had an opportunity.

Mr. Burr.

Mr. BURR. Thank you, Mr. Chairman. Mr. Grainger, does this mean we're not going to have tomatoes?

Mr. GRAINGER. Good possibility.

Mr. BURR. There is a real possibility?

Mr. GRAINGER. There is a real possibility there.

Mr. BURR. As I understand it and I read the testimony, I believe USDA is going to testify in support of the continued use of methyl bromide. I guess I really want to stay concentrated on the issue of methyl bromide for a second because I found it very interesting as I have gone through to research it and I would like to really direct a few questions to you folks who are farmers. And Mr. Pavich, how many alternatives have you experimented with in your particular family farm to methyl bromide?

Mr. PAVICH. We have actively experimented in about three or four alternatives to methyl bromide.

Mr. BURR. How many of those experimental processes or substitutes have you found to be successful?

Mr. PAVICH. At this time, we have not found any that we feel that are economically viable to the point where we are willing to risk our entire investment, and being a perennial crop, our crops will be in the ground for 20 to 40 years. It's a very big consideration.

Mr. BURR. So to your family, given that we don't have a successful replacement currently, you would see that as a threat to your overall farming operation?

Mr. PAVICH. I would see that as a threat, yes. And especially in the light that if I have to compete in the marketplace with other farmers and farmers from other countries, I have to make sure that I can remain competitive in quality and in cost.

Mr. BURR. Do you export your product?

Mr. PAVICH. We do.

Mr. BURR. You do. And are you competitive today?

Mr. PAVICH. Yes, we are.

Mr. BURR. And if we were to not have methyl bromide, would you be competitive?

Mr. PAVICH. The effects of losing methyl bromide for the grape industry and in our circumstance would be longer term. We may not see the effects as far as competitiveness for several years down the road because it is a long term effect—the soil pests that are controlled by methyl bromide have a longer term effect on the plants, so perhaps 5 or 10 years down the road we would see that. Unlike an annual crop that has to be fumigated annually, you would see those effects immediately.

Mr. BURR. Mr. Grainger, if I could, let me shift to the other side of the country into Florida. What would happen to farmers in Florida if we didn't have methyl bromide?

Mr. GRAINGER. From a personal standpoint, we would evaluate if we could be competitive without it. If we could be satisfied and be competitive and be successful with a 50 to maybe a 75 percent crop. Speaking for the whole industry, I think it would involve an evaluation process by each individual. What they can stand financially if there are alternatives out there, if they can be competitive.

Mr. BURR. But there is an economic impact?

Mr. GRAINGER. There is a major economic impact.

Mr. BURR. Let me ask you, because I know very little about methyl bromide, what type—when you inject it into the ground, what type of safety equipment, goggles and masks and this type of thing do you wear?

Mr. GRAINGER. Well, first of all, before we inject anything, we go through a training process and the manufacturer will come out and train all our people so they are certified, whether they are on the end of a shovel or driving a tractor or at the supervisor level.

On each unit, there is the proper equipment. It looks almost like a scuba diving outfit that's attached to each tractor and there is adequate water for a wash down. On a tractor naturally you can't install a portable shower. And also in—

Mr. BURR. This equipment is for what reason?

Mr. GRAINGER. It's for safety mechanisms for the methyl bromide to keep the people safe and to make sure that they are aware of what's going on and in the event of a spill or something, that it's a safe environment for work in.

Mr. BURR. OK.

Mr. BARTON. The gentleman's time is expired.

Mr. BURR. One last question, if I could, Mr. Chairman. It would be very brief. Let me just direct it to Mr. Ziller.

I found it interesting in your testimony that you said methyl bromide is naturally created or naturally occurs. Can you expand on that just a little bit and let me ask you, are there studies that suggest the level relative to the level that we use in farming today?

Mr. ZILLER. I could get back to you, but perhaps people later in the day can speak to that more directly. From what I read, the level is substantial. It's not any insignificant amount, it does come from metabolism that takes place in the ocean and compared to the agricultural and certainly the uses that I'm talking about for the food industry, they are minor compared to the substantial quantity that comes, but I don't know the percentage figure.

Mr. BURR. OK.

Mr. COX. If the gentleman would yield, we have testimony later on from Dr. Robert G. Watson from the Office of Science and Technology Policy that methyl bromide, being just one of many ozone depleting compounds, represents somewhere between a third and an eighth of what the ocean represents.

Mr. BURR. Well, I thank my colleague.

Mr. COX. I'm sorry. Methyl bromide in farming represents roughly a third of what the ocean produces. And if on the low side the estimates of what agriculture produces is correct and on the high side what the ocean produces is correct, you get eight times more from the ocean.

Mr. BURR. Let me—

Mr. BARTON. The Chair is going to have to suspend. It is always beneficial to have the input from Members of Congress, but we do have a certain protocol and the Chair would now recognize Ms. Furse of Oregon.

Ms. FURSE. Thank you. This has been very, very interesting to me because I, as Mr. Wyden says, represent small crop growers, in particular the products for gardening. But I'm also the first vineyard owner to become a Member of Congress and have actually planted a vineyard and worked on a vineyard and so I know the dangers of pesticide exposure. And I was very pleased to hear your testimony, Mr. Grainger, of the trials you go through to make things safe.

So I am trying to balance safety and economics.

Mr. Pavich, I have learned such a lot from your testimony I am taking it home. I am going to tell my husband all about it.

Mr. Pavich, one of the things that I am concerned about is we are not investing in research. I recently tried to get \$750,000 into the small crop research centers through—\$750,000, very little. We only could get \$212,000 for small crop research. We have a center in Corvallis, Oregon. And they do this research.

Also, there are private companies who are doing the research. There's a company called Vinefra which produces phylloxera-resistant root stock for grapes through extensive research.

Could you talk a little bit about what you think is necessary for us to answer the problems that farmers have, and I understand those problems, so that we can produce the kind of safe alternatives that you spoke of that Mr. Grainger, I know, wants because he doesn't want to haul all this equipment around to keep his workers safe and I as a farmer don't want to have to be worried about it. What is our best opportunity? Are you optimistic that we can find an answer?

Do you think, Mr. Pavich, we can find an answer to these dangerous compounds?

Mr. PAVICH. I share the same concern that you have as far as the lack of good research, good quality research. In my testimony, I stated that a very small nonprofit research foundation that I sit on the board of has funded 48 projects to study alternatives to our current modern day chemical technology and we have been very, very successful.

Just pouring money at the problem isn't necessarily the answer. The USDA and other government institutions spend millions of dollars on research. But our concern in the organic farming industry is that it is not the type of quality of research that's, in fact, getting results. So I would encourage the direction our efforts toward research areas that have proven track records and that can give us the type of results that we need and those, as I stated in my testimony, that do not conduct their research in laboratory-type environments. You need to get out there with the farmers and do the research on the farms, not in a test plot at the research station. You need to work with farmers and set up test plots on their farms and I think that in the long run that we can learn a lot.

Mother Nature has made farming extremely complex and there's so little that we really know about farming and agriculture. When we first began farming organically, we didn't know the first thing

about how it all worked and we still don't know that much about it, but what we do know that it is extremely complex and there are things that we felt that were insurmountable and as we developed our farming system, many problems that we were terrified over seemed to go away by themselves.

Now, I can't sit here and guarantee that that will happen with the problems that we face in seeking out alternatives to methyl bromide, but certainly I do share—I have a certain level of hope that we can in the long run find some alternative, but we need some time.

Ms. FURSE. Thank you. My time is expired.

I did want to just comment that Austria, Denmark, Germany, Italy, the Netherlands, Norway, and Sweden have all moved toward banning of or phasing out methyl bromide because skin cancer is now the largest cancer killer of males in the world and we do see this connection.

And so I, like you, am optimistic that we can find some alternatives. I know every one of these dedicated farmers is always looking for a better method and so we will try and get some research dollars in the right place.

Thank you, Mr. Chairman.

Mr. BARTON. Thank you. Seeing no other members of the subcommittee that haven't asked a question, the Chair would recognize Mr. Miller.

Mr. MILLER OF FLORIDA. Let me just make a statement. It was interesting to hear the comments today, but two things that I think I found out, there is a wide variety of uses. I know in my area of Florida, as Mr. Grainger said, we have a very humid area. We have two crops a year and two crops a year would not even be feasible without use of the methyl bromide, whereas the need for a maritime situation because of the getting-rid-of-pesticide type of thing. The fumigant type of thing is a whole different issue, and when you have crops like grapes, similar to citrus, where you can use it for years without replanting twice a year, it is a very different usage. It is used in very diverse areas and different parts of the country and just as important to each area.

Another thing is everybody is saying they want a change. No one wants to just swear to methyl bromide. That's encouraging. Everybody really wants to change. It is expensive and the safety factors and everything else. Everybody is moving in the right direction and we get back to the issue of fairness, so I feel very encouraged from hearing the comments from people who actually deal with this on a day-to-day basis.

Thank you, Mr. Chairman.

Mr. BARTON. Thank you. The Chair would then recognize Mr. Farr.

Mr. FARR. Thank you very much, Mr. Chairman.

I would also like to point out to the committee that with the organic, we have in California a certified organic law which sets up the protocols for people growing organically and therefore when they claim it is organic, that can be traced and enforced and a lot of other States don't have that. It has created a certainty for the market. The market is limited.

I think the real question here and I don't know whether to direct it to this panel or the next one is that, indeed, if the science community says that methyl bromide is an ozone-depleting chemical, then we really ought to eliminate it worldwide and we ought to also measure that in terms of what nature is producing and see whether what we are using commercially is in contrast to how much nature—the percentage that nature is producing because what we have—what we are faced here with is just kind of a unilateral disarmament for farmers of an effective tool.

And there doesn't seem to be any ability in the short term to find an alternative to that tool. Therefore, what you are seeing up here today, no one has indicated to the committee or to the country that they are not interested in using an effective alternative, but indeed it has to be effective and that hasn't been discovered yet.

We have got 5 years and we drop dead, so it is important for Congress to put all the effort it can to make sure that we can stay in business and be competitive worldwide because every one of these gentlemen here produces or is involved with fruits and vegetables that not only we consume in this country, but are exported to other countries as well.

And what we heard today is that you are not going to be able to get in nor get out because of American law and as lawmakers we need to make sure that that law is essentially fair and just and if indeed it is this big of an environmental risk, then it is applied equally around the world. I don't know if there is a response to that, but perhaps save it for the next panel.

I would like to thank the panel for coming and particularly constituents of mine, Clinton and Karen Miller.

Mr. BARTON. We thank the gentleman from California for your statement. Does the ranking member wish one or two more questions?

Mr. WYDEN. I don't think so, Mr. Chairman.

Mr. BARTON. Then we want to thank each of you gentlemen for coming literally from both sides of the country: The West Coast and the East Coast. Your testimony has been very enlightening and we are going to review it very seriously.

We would now like to hear from our second panel. If you would come forward. We have Dr. Robert Watson, the Associate Director for the Environment, Office of Science and Technology Policy. We have Dr. Fred Singer, who is President of the Science and Environmental Policy Project in Fairfax, Virginia.

Mr. BARTON. The committee will come to order. Each of you gentlemen have been informed that it is the tradition of this subcommittee to take testimony under oath. Do either of you have objection to that? You are also to be advised that under the rules of the House and of this subcommittee you have the right to be advised by counsel. Do you so wish to exercise this right during your testimony?

Will you then stand and raise your right hand, please.

[Witnesses sworn.]

Mr. BARTON. Dr. Watson, your statement will be accepted for the record. If you could summarize it in 5 minutes orally, we would appreciate that.

TESTIMONY OF ROBERT WATSON, ASSOCIATE DIRECTOR FOR THE ENVIRONMENT, OFFICE OF SCIENCE AND TECHNOLOGY POLICY; AND S. FRED SINGER, PRESIDENT, THE SCIENCE AND ENVIRONMENTAL POLICY PROJECT

Mr. WATSON. Thank you. Mr. Chairman, members of subcommittee, it's a real pleasure to be here today to discuss the issue of stratospheric ozone depletion. What I'll do today is briefly summarize the most important aspects of ozone depletion and then focus on the specific role of methyl bromide.

What I want to stress is that these conclusions are taken from the 1994 report, which is an international assessment conducted under the auspices of the United Nations and it's basically reported by hundreds of scientists from academia, industry, environmental organizations, and government laboratories.

I believe that this represents the very large majority opinion of the scientific community, in contrast to the views you will hear in a few seconds of Fred Singer, which I believe represents a very small minority of one or maybe two people.

All international regulations have been based on these assessments, not as asserted by Dr. Singer in his testimony, on NASA press statements. Most other governments of the world don't care about NASA press statements. What they care about is international consensus forged by academia and industry scientists together.

What I'd like to do is quickly summarize the key issues. Ozone depletion has been observed over the whole globe, all seasons and all latitudes except in the tropics. This ozone depletion basically accounts at the moment for about 5 to 6 percent over the United States in summer and about double that in winter.

In addition, the weight of the scientific evidence—this is based on observations, laboratory studies, and theoretical models—suggest that the observed ozone losses in mid latitude are largely due to human activities, human activities emitting chlorine and bromine into the atmosphere.

We believe that stratospheric ozone, the peak depletion will peak within a couple of years, probably about 1998. The reason is we believe that stratospheric chlorine and bromine will also peak at that particular time, basically because of the very successful Montreal Protocol and subsequent amendments and adjustments.

We believe that it will peak at about 6 to 7 percent ozone loss in northern mid latitudes in summer and fall; 12 to 13 percent ozone loss in winter and spring in northern mid latitudes; and about 11 percent year-round in the southern hemisphere.

Now, these will be accompanied by large increases in ultraviolet radiation. About 15 percent in winter and northern mid latitudes, 8 percent in summer; 13 percent in the southern hemisphere year-round.

There are only a few ways we can further reduce the threat to the ozone layer and one of those is indeed a global ban on methyl bromide. If there were to be a global ban on methyl bromide, that is all countries developed and developing, then we could effectively reduce the threat to the ozone layer, the cumulative loss of ozone over the next 50 years by about 13 percent, not insignificant. I would also like to remind people that the Antarctic ozone hole in

1992, 93, and 94, was the deepest and the broadest on record. And that this Antarctic ozone hole is without question due to human activities chlorine and bromine.

The natural abundance of chlorine is only 0.6 parts per billion; that's parts in 10 to the 9th. We know human activities have increased it from 0.6 to 3.5, basically a factor of six. Bromine has also gone up slightly because of our use of halons and our use of methyl bromide.

It is not primarily due to the cause that you will hear from Fred Singer, a small increase in the amount of water vapor coming from the oxidation of the methane or the slight cooling of the stratosphere due to CO-2, or what I would assert, ozone depletion itself. Those two factors will indeed make it worse, but the primary cause is human activities emitting chlorine and bromine.

We've also observed over Antarctica and Australia that when ozone is low, ultraviolet is high. So we have ascertained what you would expect from the first principles of physics that in clear sky conditions you reduce ozone, ultraviolet radiation increases. We have no long-term proof that there are trends in ultraviolet radiation.

Our measurement system is not good enough at the moment, to be quite honest, to discern any trend in ultraviolet radiation. We have seen a decrease in ozone. We have not yet, because of inadequate observations, seen an increase in ultraviolet radiation.

Why do we care about ultraviolet radiation and ozone depletion? Quite clearly, it has an adverse effect on human health, ecological systems and actually air quality. But let me focus on human health. It is very well established that it is a direct link between ozone depletion and non-melanoma skin cancer and eye cataracts.

With respect to methyl bromide, it has four sources. The ocean is a natural source, probably the single largest source, 95 kilotons per year. Three other sources are soil fumigation, as you've heard from the first panel; leaded gasoline; and biomass burning. In total 40 percent of methyl bromide is of anthropogenic origin, human-induced. Of that 35 kilotons is, as I say, from soil fumigation.

We've measured methyl bromide in the atmosphere quite accurately. We understand interhemispheric ratio. We understand it is lost by atmospheric removal processes, oceanic removal processes, and possibly soil processes. The international assessment said the best estimate for methyl bromide was the lifetime of 1.3 years with an ozone depleting potential of about 0.6.

Bromine per molecule or per ton is about 50 times more efficient than chlorine in destroying stratospheric ozone, hence bromine today is responsible for about a quarter of all the ozone loss that is currently going on both globally and in the polar regions.

Some new investigations have suggested a soil sink that might reduce the efficiency of bromine somewhat, but there has been some other kinetic measurements that suggest bromine might be even more efficient than we previously thought.

So the bottom line summary is human activities are affecting ozone. We have demonstrated definitively with observations. It's broadly consistent with theoretical observation. Methyl bromide is a key player and it is one of the ways that if there were to be a global ban we could actually reduce further levels of ozone deple-

tion beyond what we have predicted with the Copenhagen amendments to the Montreal Protocol. Thank you.

[The prepared statement of Robert T. Watson follows:]

PREPARED STATEMENT OF ROBERT T. WATSON, ASSOCIATE DIRECTOR OF ENVIRONMENT, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Mr. Chairman and Members of the Committee: I am pleased to be here today to discuss the scientific aspects of ozone depletion. The concern of governments over ozone depletion has resulted in regular comprehensive international scientific, environmental impacts, technical and economic assessments being performed under the auspices of the World Meteorological Organization and the United Nations Environment Programme.

In 1994, three state-of-the-art assessments were conducted in response to the mandate of the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer. These assessments included: (i) an assessment of our understanding of the processes controlling the present distribution and rate of change of atmospheric ozone; (ii) an assessment of the environmental impacts of ozone depletion; and (iii) an assessment of the technological feasibility and economic costs associated with the substitution of substances controlled under the Montreal Protocol. The scientific assessment was co-chaired by Dr. Albritton of NOAA and myself; the impacts assessment was co-chaired by Dr. Jan van der Leun of the Netherlands and Dr. Manfred Tevini of Germany; and the technology/economics assessment was chaired by Dr. Stephen Anderson of U.S. EPA.

My testimony today will briefly summarize the most important aspects of ozone depletion, and then focus on the specific role of methyl bromide. These conclusions are primarily taken from the 1994 assessment. Hundreds of experts from academia, government laboratories, industry, and environmental organizations are involved in the preparation and peer-review of these international assessments. Hence these assessments represent the very large majority opinion of the world's scientific community. In addition, I have highlighted some of the more recent scientific findings that are pertinent to this hearing. The executive summary of the 1994 International Scientific Assessment of Ozone Depletion is presented verbatim in the Appendix to this testimony.

GLOBAL AND POLAR OZONE DEPLETION

Global Ozone Depletion

Ozone Depletion has been observed over much of the globe: Analysis of ground-based and satellite global total-column ozone data through early 1994 shows substantial decreases of ozone in all seasons at midlatitudes (30°-60°) of both hemispheres. For example, in the middle latitudes of the Northern Hemisphere, downward trends of about 6% per decade over 1979-1994 were observed in winter and spring and about 3% per decade were observed in summer and fall. In the Southern Hemisphere, the seasonal difference was somewhat less, but the midlatitude trends averaged a similar 4% to 5% per decade. There are no statistically significant trends in the tropics (20°S-20°N). At Northern midlatitudes, the downward trend in ozone between 1981-1991 was about 2% per decade greater compared to that of the period 1970-1980.

The weight of scientific evidence suggests that observed middle- and high-latitude ozone losses are largely due to anthropogenic chlorine and bromine compounds. Direct *in situ* measurements of radical species in the lower stratosphere, coupled with model calculations, have quantitatively shown that the *in situ* photochemical loss of ozone due to (largely natural) reactive nitrogen (NO_x) compounds is smaller than that predicted from gas phase chemistry, while that due to (largely natural) HO_x compounds and (largely anthropogenic) chlorine and bromine compounds is larger than that predicted from gas phase chemistry. This confirms the key role of chemical reactions on sulfate aerosols in controlling the chemical balance of the lower stratosphere.

Peak global ozone losses are expected to occur during the next several years. Human-induced ozone layer depletion is expected to peak around 1998, since the peak stratospheric chlorine and bromine abundances are expected to occur then. Based on extrapolation of current trends, observations suggest that the maximum ozone loss, relative to the late 1960s, will likely be: (i) about 12-13% at Northern midlatitudes in winter/spring; (ii) about 6-7% at Northern midlatitudes in summer/

fall; and (iii) about 11% (with less certainty) at Southern midlatitudes on a year-round basis.

These projected changes in column ozone would be accompanied by 15%, 8%, and 13% increases, respectively, in surface erythral radiation, if other influences such as clouds remain constant.

Approaches to lowering stratospheric chlorine and bromine abundances are limited. Further controls on ozone-depleting substances would not be expected to significantly change the timing or the magnitude of the peak stratospheric halocarbon abundances and hence peak ozone loss. However, there are four approaches that would steepen the initial fall from the peak halocarbon levels in the early decades of the next century:

If emissions of methyl bromide from agricultural, structural, and industrial activities were to be eliminated in the year 2001, then the integrated effective future chlorine loading above the 1980 level (which is related to the cumulative future loss of ozone) is predicted to be 13% less over the next 50 years relative to full compliance to the Amendments and Adjustments to the Protocol.

If emissions of HCFCs were to be totally eliminated by the year 2004, then the integrated effective future chlorine loading above the 1980 level is predicted to be 5% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol.

If halons presently contained in existing equipment were never released to the atmosphere, then the integrated effective future chlorine loading above the 1980 level is predicted to be 10% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol.

If CFCs presently contained in existing equipment were never released to the atmosphere, then the integrated effective future chlorine loading above the 1980 level is predicted to be 3% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol.

Polar Ozone Depletion:

The Antarctic ozone "holes" of 1992 and 1993 were the most severe on record. The Antarctic ozone "hole" has continued to occur seasonally every year since its advent in the late-1970s, with the occurrences over the last several years being particularly pronounced. Satellite, balloon-borne, and ground-based monitoring instruments revealed that the Antarctic ozone "holes" of 1992 and 1993 were the biggest (areal extent) and deepest (minimum amounts of ozone overhead), with ozone being locally depleted by more than 99% between about 14-19 km in October, 1992 and 1993. It is likely that these larger-than-usual ozone depletions could be attributed, at least in part, to sulfate aerosols from Mt. Pinatubo increasing the effectiveness of chlorine- and bromine-catalyzed ozone destruction. A substantial Antarctic ozone "hole" is expected to occur each austral spring for many more decades because stratospheric chlorine and bromine abundances will approach the pre-Antarctic-ozone-"hole" levels (late-1970s) very slowly during the next century.

Anthropogenic chlorine and bromine compounds are the cause of polar ozone depletion. Laboratory studies have provided a greatly improved understanding of how the chemistry on the surfaces of ice, nitrate, and sulfate particles can increase the abundance of ozone-depleting forms of chlorine in the polar stratospheres. Furthermore, satellite and *in situ* observations of the abundances of reactive nitrogen and chlorine compounds have improved the explanation of the different ozone-altering properties of the Antarctic and Arctic.

Ozone losses have been detected in the Arctic winter stratosphere: linked to halogen chemistry. Studies in the Arctic lower stratosphere have been expanded to include more widespread observations of ozone and key reactive species. In the late-winter/early-spring period, additional chemical losses of ozone up to 15-20% at some altitudes are deduced from these observations, particularly in the winters of 1991/2 and 1992/3. Model calculations constrained by the observations are also consistent with these losses, increasing the confidence in the role of chlorine and bromine in ozone destruction. The interannual variability in the photochemical and dynamical conditions of the Arctic polar vortex continues to limit the ability to predict ozone changes in future years.

Since the 1994 assessment there have been two major findings: (i) the 1994 Antarctic ozone hole was as deep and as extensive as those in 1992 and 1993; and (ii) ozone levels in the winter of 1994/95 over the Arctic were low as expected, due to the combination of high levels of chlorine and bromine coupled with persistent cold temperatures in the stratosphere and meteorological conditions.

Ozone Depletion and Ultraviolet Radiation:

The link between a decrease in stratospheric ozone and an increase in surface ultraviolet (UV) radiation has been further strengthened. Measurements of UV radiation at the surface under clear-sky conditions show that low overhead ozone yields high UV radiation and in the amount predicted by radiative-transfer theory. Large increases of surface UV are observed in Antarctica and the southern part of South America during the period of the seasonal ozone "hole." Furthermore, elevated surface UV levels at mid-to-high latitudes were observed in the Northern Hemisphere in 1992 and 1993, corresponding to the low ozone levels of those years. However, the lack of a decadal (or longer) record of accurate monitoring of surface UV levels and the variation introduced by clouds and other factors have precluded the unequivocal identification of a long-term trend in surface UV radiation.

Increases in UV-B radiation are likely to have substantial adverse effects on human health, including increases in the incidence of and morbidity from skin cancer, eye diseases, and infectious diseases. In susceptible (light-skinned) populations, UV-B radiation is the key risk factor for the development of non-melanoma skin cancer. Using information derived from animal experiments and human epidemiology, it is estimated that a sustained 1% decrease in stratospheric ozone will result in an increase of approximately 2% in the increase of non-melanoma skin cancer. Epidemiological data indicate that the risk of melanoma increases with sunlight exposure, especially during childhood. Chronic exposure to UV-B (resulting in a high cumulative, lifetime dose) is one of several factors clearly associated with the risk of cataracts. Studies of humans indicate that UV-B radiation can induce suppression of immune systems. The importance of these immune effects for infectious diseases in humans is unknown. However, in areas of the world where infectious diseases already pose a significant challenge to human health and in persons with impaired immune function, the added impact of UV-B-induced immune suppression could be significant.

Increases in UV-B adversely affect ecological systems. UV-B adversely affects the physiological and developmental processes of plants, phytoplankton productivity, and the early development stages of fish and other aquatic organisms.

ROLE OF METHYL BROMIDE

Methyl bromide continues to be viewed as a significant ozone-depleting compound: Four potentially major sources for atmospheric methyl bromide (CH_3Br) have been identified: the ocean, which is a natural source, and three others that are most entirely anthropogenic; these are agricultural usage, which has been reaffirmed, biomass burning, which is newly recognized, and the exhaust of automobiles using lead gasoline.

The estimated uncertainty range for these sources is large, with oceans ranging from 60 to 160 ktonnes/yr, agriculture from 20 to 60 ktonnes/yr, biomass burning from 10 to 50 ktonnes/yr, and automobile exhaust from 0.5 to 22 ktonnes/yr. In the latter case, the range results from two conflicting assessments, which yield 0.5 ktonnes/yr and 9 to 22 ktonnes/yr, respectively.

There are also two minor anthropogenic sources, structural fumigation (4 ktonnes/yr) and industrial emissions (2 ktonnes/yr), each of which are well quantified.

Measurements of CH_3Br yield a global average ground-level atmospheric mixing ratio of approximately 11 pptv. These measurements also have confirmed that the concentration in the Northern Hemisphere is higher by about 30% than the concentration in the Southern Hemisphere (interhemispheric ratio of 1.3). Such a ratio requires the value of sources minus sinks in the Northern Hemisphere exceeds the same term in the Southern Hemisphere.

There is no clear long-term change in the concentration of CH_3Br during the time period of the systematic continued measurements (1978-1992). One possible explanation is that CH_3Br from automobiles may have declined while, at the same time, emissions from agricultural use may have increased, leading to relatively constant anthropogenic emissions over the last decade.

The magnitude of the atmospheric sink of CH_3Br due to gas phase chemistry is well known and leads to a lifetime of 2 ± 0.5 yr. The recently postulated oceanic sink leads to a calculated atmospheric lifetime due to oceanic hydrolysis of 3.7 yr, but there are large uncertainties (1.3 to 14 yr). Thus the overall atmospheric lifetime due to both these processes is 1.3 yr with a range of 0.8 to 1.7 yr.

Recognizing the quoted uncertainties in the size of the individual sources of CH_3Br , the most likely estimate is that about 40% of the source is anthropogenic. The major uncertainty in this number is the size of the ocean source. Based on the present atmospheric mixing ratio and the current source estimate, a lifetime of less than 0.6 yr would require identification of new major sources and sinks.

The chemistry of ozone destruction by bromine in the stratosphere is now better understood. A high rate coefficient for the $\text{HO}_2 + \text{BrO}$ reaction is confirmed and there is no evidence that it produces HBr . A conservative upper limit of 2% can be placed on the reaction channel yielding HBr . Stratospheric measurements confirm that the concentration of HBr is very low (less than 1 pptv) and that is not a significant bromine reservoir.

The combined efficiency of the bromine removal cycles for ozone ($\text{HO}_2 + \text{BrO}$ and $\text{ClO} + \text{BrO}$) is likely to be about 50 times greater than the efficiency of known chlorine removal cycles on an atom-for-atom basis.

The calculated Ozone Depletion Potential (ODP) for CH_3Br is currently estimated to be 0.6 based on an atmospheric lifetime of 1.3 years. The range of uncertainties in the parameters associated with the ODP calculation places a lower limit on the ODP of 0.3.

Since the 1994 assessment there has been considerable research activity in this area. In particular, there have been a number of new studies of the tropospheric sink mechanisms (affects the amount of methyl bromide reaching the stratosphere) and stratospheric photochemical processes (controls the efficiency of bromine in destroying stratospheric ozone).

There have been a number of recent investigations of oceanic, atmospheric and soils sink mechanisms. The provisional results (not yet critically assessed by the international community) suggest that the oceanic and atmospheric loss mechanisms are slightly more efficient than previously thought, and there may be an important soils sink. Taken together, these new studies, which need to be critically assessed, suggest the atmospheric lifetime of methyl bromide may be shorter than suggested in the 1994 assessment, possibly as short as 0.7 years compared to the 1994 assessment value of 1.3 years. This would mean that less methyl bromide would reach the stratosphere than previously thought, hence decreasing the value of the Ozone Depletion Potential (ODP). However, if the soils sink is as efficient as the provisional studies suggest, resulting in these lower tropospheric lifetimes, it makes it very difficult to reconcile the observed interhemispheric ratio of 1.3 to model simulations.

The new studies of photochemical processes include the photolysis and hydrolysis of bromine nitrate, and the reaction rate constant and product distribution of the BrO plus HO_2 reaction. The provisional results suggest that bromine nitrate may photolyze and hydrolyze more rapidly than previously assessed and that HBr is not a reaction product of the BrO plus HO_2 reaction. These results taken together suggest bromine may be more efficient than previously thought in destroying stratospheric ozone, hence increasing the value of the ODP.

All of these new results need to be carefully evaluated prior to a redetermination of a revised value for the ODP of methyl bromide.

ANNEX I

EXECUTIVE SUMMARY OF THE 1994 SCIENTIFIC ASSESSMENT OF OZONE DEPLETION

Recent Major Scientific Findings and Observations

The laboratory investigations, atmospheric observations, and theoretical and modeling studies of the past few years have provided a deeper understanding of the human-influenced and natural chemical changes in the atmosphere and their relation to the Earth's stratospheric ozone layer and radiative balance of the climate system. Since the last international scientific assessment of the state of understanding, there have been several key ozone-related findings, observations, and conclusions:

The atmospheric growth rates of several major ozone-depleting substances have slowed, demonstrating the expected impact of the Montreal Protocol and its Amendments and Adjustments. The abundances of the chlorofluorocarbons (CFCs), carbon tetrachloride, methyl chloroform, and halons in the atmosphere have been monitored at global ground-based sites since about 1978. Over much of that period, the annual growth rates of these gases have been positive. However, the data of recent years clearly show that the growth rates of CFC-11, CFC-12, halon-1301, and halon-1211 are slowing down. In particular, total tropospheric organic chlorine increased by only about 60 ppt/year (1.6%) in 1992, compared to 110 ppt/year (2.9%) in 1989. Furthermore, tropospheric bromine in halons increased by only about 0.25 ppt/year in 1992, compared to about 0.85 ppt/year in 1989. The abundance of carbon tetrachloride is actually decreasing. The observed trends in total tropospheric organic chlorine are consistent with reported production data, suggesting less emission than the maximum allowed under the Montreal Protocol and its Amendments and Adjustments. Peak total chlorine/bromine loading in the troposphere is expected to

occur in 1994, but the stratospheric peak will lag by about 3-5 years. Since the stratospheric abundances of chlorine and bromine are expected to continue to grow for a few more years, increasing global ozone losses are predicted (other things being equal) for the remainder of the decade, with gradual recovery in the 21st century.

The atmospheric abundances of several of the CFC substitutes are increasing, as anticipated. With phaseout dates for the CFCs and other ozone-depleting substances now fixed by international agreements, several hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) are being manufactured and used as substitutes. The atmospheric growth of some of these compounds (e.g., HCFC-22) has been observed for several years, and the growth rates of others (e.g., HCFC-142b and HCFC-141b) are now being monitored. Tropospheric chlorine in HCFCs increased by 5 ppt/year in 1989 and about 10 ppt/year in 1992.

Record low global ozone levels were measured over the past two years. Anomalous ozone decreases were observed in the midlatitudes of both hemispheres in 1992 and 1993. The Northern Hemispheric decreases were larger than those in the Southern Hemisphere. Globally, ozone values were 1-2% lower than would be expected from an extrapolation of the trend prior to 1991, allowing for solar-cycle and quasi-biennial-oscillation (QBO) effects. The 1994 global ozone levels are returning to values closer to those expected from the longer-term downward trend.

The stratosphere was perturbed by a major volcanic eruption. The eruption of Mt. Pinatubo in 1991 led to a large increase in sulfate aerosol in the lower stratosphere throughout the globe. Reactions on sulfate aerosols resulted in significant, but temporary, changes in the chemical partitioning that accelerated the photochemical ozone loss associated with reactive hydrogen (HO_x), chlorine, and bromine compounds in the lower stratosphere in midlatitudes and polar regions. Absorption of terrestrial and solar radiation by the Mt. Pinatubo aerosol resulted in a transitory rise of 1°C (globally averaged) in the lower-stratospheric temperature and also affected the distribution of ozone through circulation changes. The observed 1994 recovery of global ozone is qualitatively consistent with observed gradual reductions of the abundances of these volcanic particles in the stratosphere.

Downward trends in total-column ozone continue to be observed over much of the globe, but their magnitudes are underestimated by numerical models. Decreases in ozone abundances of about 4-5% per decade at midlatitudes in the Northern and Southern Hemispheres continue to be observed by both ground-based and satellite-borne monitoring instruments. At midlatitudes, the losses continue to be much larger during winter/spring than during summer/fall in both hemispheres, and the depletion increases with latitude, particularly in the Southern Hemisphere. Little or no downward trends are observed in the tropics (20°N - 20°S). While the current two-dimensional stratospheric models simulate the observed trends quite well during some seasons and latitudes, they underestimate the trends by factors of up to three in winter/spring at mid- and high latitudes. Several known atmospheric processes that involve chlorine and bromine and that affect ozone in the lower stratosphere are difficult to model and have not been adequately incorporated into these models.

Observations have demonstrated that halogen chemistry plays a larger role in the chemical destruction of ozone in the midlatitude lower stratosphere than expected from gas phase chemistry. Direct *in situ* measurements of radical species in the lower stratosphere, coupled with model calculations, have quantitatively shown that the *in situ* photochemical loss of ozone due to (largely natural) reactive nitrogen (NO_x) compounds is smaller than that predicted from gas phase chemistry, while that due to (largely natural) HO_x compounds and (largely anthropogenic) chlorine and bromine compounds is larger than that predicted from gas phase chemistry. This confirms the key role of chemical reactions on sulfate aerosols in controlling the chemical balance of the lower stratosphere. These and other recent scientific findings strengthen the conclusion of the previous assessment that the weight of scientific evidence suggests that the observed middle- and high-latitude ozone losses are largely due to anthropogenic chlorine and bromine compounds.

The conclusion that anthropogenic chlorine and bromine compounds, coupled with surface chemistry on natural polar stratospheric particles, are the cause of polar ozone depletion has been further strengthened. Laboratory studies have provided a greatly improved understanding of how the chemistry on the surfaces of ice, nitrate, and sulfate particles can increase the abundance of ozone-depleting forms of chlorine in the polar stratospheres. Furthermore, satellite and *in situ* observations of the abundances of reactive nitrogen and chlorine compounds have improved the explanation of the different ozone-altering properties of the Antarctic and Arctic.

The Antarctic ozone "holes" of 1992 and 1993 were the most severe on record. The Antarctic ozone "hole" has continued to occur seasonally every year since its advent in the late-1970s, with the occurrences over the last several years being particularly pronounced. Satellite, balloon-borne, and ground-based monitoring instruments re-

vealed that the Antarctic ozone "holes" of 1992 and 1993 were the biggest (areal extent) and deepest (minimum amounts of ozone overhead), with ozone being locally depleted by more than 99% between about 14-19 km in October, 1992 and 1993. It is likely that these larger-than-usual ozone depletions could be attributed, at least in part, to sulfate aerosols from Mt. Pinatubo increasing the effectiveness of chlorine- and bromine-catalyzed ozone destruction. A substantial Antarctic ozone "hole" is expected to occur each austral spring for many more decades because stratospheric chlorine and bromine abundances will approach the pre-Antarctic-ozone-"hole" levels (late-1970s) very slowly during the next century.

Ozone losses have been detected in the Arctic winter stratosphere, and their links to halogen chemistry have been established. Studies in the Arctic lower stratosphere have been expanded to include more widespread observations of ozone and key reactive species. In the late-winter/early-spring period, additional chemical losses of ozone up to 15-20% at some altitudes are deduced from these observations, particularly in the winters of 1991/2 and 1992/3. Model calculations constrained by the observations are also consistent with these losses, increasing the confidence in the role of chlorine and bromine in ozone destruction. The interannual variability in the photochemical and dynamical conditions of the Arctic polar vortex continues to limit the ability to predict ozone changes in future years.

The link between a decrease in stratospheric ozone and an increase in surface ultraviolet (UV) radiation has been further strengthened. Measurements of UV radiation at the surface under clear-sky conditions show that low overhead ozone yields high UV radiation and in the amount predicted by radiative-transfer theory. Large increases of surface UV are observed in Antarctica and the southern part of South America during the period of the seasonal ozone "hole." Furthermore, elevated surface UV levels at mid-to-high latitudes were observed in the Northern Hemisphere in 1992 and 1993, corresponding to the low ozone levels of those years. However, the lack of a decadal (or longer) record of accurate monitoring of surface UV levels and the variation introduced by clouds and other factors have precluded the unequivocal identification of a long-term trend in surface UV radiation.

Methyl bromide continues to be viewed as a significant ozone-depleting compound. Increased attention has been focused upon the ozone-depleting role of methyl bromide. Three potentially major anthropogenic sources of atmospheric methyl bromide have been identified (soil fumigation, biomass burning, and the exhaust of automobiles using leaded gasoline), in addition to the natural oceanic source. Recent laboratory studies have confirmed the fast rate for the $\text{BrO} + \text{HO}_2$ reaction and established a negligible reaction pathway producing HBr, both of which imply greater ozone losses due to emissions of compounds containing bromine. While the magnitude of the atmospheric photochemical removal is well understood, there are significant uncertainties in quantifying the oceanic sink for atmospheric methyl bromide. The best estimate for the overall lifetime of atmospheric methyl bromide is 1.3 years, with a range of 0.8-1.7 years. The Ozone Depletion Potential (ODP) for methyl bromide is calculated to be about 0.6 (relative to an ODP of 1 for CFC-11).

Stratospheric ozone losses cause a global-mean negative radiative forcing. In the 1991 scientific assessment, it was pointed out that the global ozone losses that were occurring in the lower stratosphere caused this region to cool and result in less radiation reaching the surface-troposphere system. Recent model studies have strengthened this picture. A long-term global-mean cooling of the lower stratosphere of between 0.25 and 0.4°C/decade has been observed over the last three decades. Calculations indicate that, on a global mean, the ozone losses between 1980 and 1990 offset about 20% of the radiative forcing due to the well-mixed greenhouse-gas increases during that period (i.e., carbon dioxide, methane, nitrous oxide, and halocarbons).

Tropospheric ozone, which is a greenhouse gas, appears to have increased in many regions of the Northern Hemisphere. Observations show that tropospheric ozone, which is formed by chemical reactions involving pollutants, has increased above many locations in the Northern Hemisphere over the last 30 years. However, in the 1980s, the trends were variable, being small or nonexistent. In the Southern Hemisphere, there are insufficient data to draw strong inferences. At the South Pole, a decrease has been observed since the mid-1980s. Model simulations and limited observations suggest that tropospheric ozone has increased in the Northern Hemisphere since pre-industrial times. Such changes would augment the radiative forcing from all other greenhouse gases by about 20% over the same time period.

The atmospheric residence times of the important ozone-depleting gases, CFC-11 and methyl chloroform, and the greenhouse gas, methane, are now better known. A reconciliation of observed concentrations with known emissions using an atmospheric model has led to a best-estimate lifetime of 50 years for CFC-11 and 5.4 years for methyl chloroform, with uncertainties of about 10%. These lifetimes provide an accurate standard for gases destroyed only in the stratosphere (such as

CFCs and nitrous oxide) and for those also reacting with tropospheric hydroxyl radical, OH (such as HCFCs and HFCs), respectively. Recent model simulations of methane perturbations and a theoretical analysis of the tropospheric chemical system that couples methane, carbon monoxide, and OH have demonstrated that methane perturbations decay with a lengthened time scale in a range of about 12-17 years, as compared with the 10-year lifetime derived from the total abundance and losses. This longer response time and other indirect effects increase the estimate of the effectiveness of emissions of methane as a greenhouse gas by a factor of about two compared to the direct-effect-only values given in the 1991 assessment.

SUPPORTING SCIENTIFIC EVIDENCE AND RELATED ISSUES

Ozone Changes in the Tropics and Midlatitudes and Their Interpretation

Analysis of global total-column ozone data through early 1994 shows substantial decreases of ozone in all seasons at midlatitudes (30°-60°) of both hemispheres. For example, in the middle latitudes of the Northern Hemisphere, downward trends of about 6% per decade over 1979-1994 were observed in winter and spring and about 3% per decade were observed in summer and fall. In the Southern Hemisphere, the seasonal difference was somewhat less, but the midlatitude trends averaged a similar 4% to 5% per decade. There are no statistically significant trends in the tropics (20°S-20°N). Trends through 1994 are about 1% per decade more negative in the Northern Hemisphere (2% per decade in the midlatitude winter/spring in the Northern Hemisphere) compared to those calculated without using data after May 1991. At Northern midlatitudes, the downward trend in ozone between 1981-1991 was about 2% per decade greater compared to that of the period 1970-1980.

Satellite and ozonesonde data show that much of the downward trend in ozone occurs below 25 km (i.e., in the lower stratosphere). For the region 20-25 km, there is good agreement between the trends from the Stratospheric Aerosol and Gas Experiment (SAGE I/II) satellite instrument data and those from ozonesondes, with an observed annual-average decrease of 7±4% per decade from 1979 to 1991 at 30°-50°N latitude. Below 20 km, SAGE yields negative trends as large as 20±8% per decade at 16-17 km, while the average of available midlatitude ozonesonde data shows smaller negative trends of 7±3% per decade. Integration of the ozonesonde data yields total-ozone trends consistent with total-ozone measurements. In the 1980s, upper-stratospheric (35-45 km) ozone trends determined by the data from SAGE I/II, Solar Backscatter Ultraviolet satellite spectrometer (SBUV), and the Umkehr method agree well at midlatitudes, but less so in the tropics. Ozone declined 5-10% per decade at 35-45 km between 30°-50°N and slightly more at southern midlatitudes. In the tropics at 45 km, SAGE I/II and SBUV yield downward trends of 10 and 5% per decade, respectively.

Simultaneous *in situ* measurements of a suite of reactive chemical species have directly confirmed modeling studies implying that the chemical destruction of ozone in the midlatitude lower stratosphere is more strongly influenced by HO_x and halogen chemistry than NO_x chemistry. The seasonal cycle of ClO in the lower stratosphere at midlatitudes in both hemispheres supports a role for *in situ* heterogeneous perturbations (i.e., on sulfate aerosols), but does not appear consistent with the timing of vortex processing or dilution. These studies provide key support for the view that sulfate aerosol chemistry plays an important role in determining midlatitude chemical ozone destruction rates.

The model-calculated ozone depletions in the upper stratosphere for 1980-1990 are in broad agreement with the measurements. Although these model-calculated ozone depletions did not consider radiative feedbacks and temperature trends, including these effects is not likely to reduce the predicted ozone changes by more than 20%.

Models including the chemistry involving sulfate aerosols and polar stratospheric clouds (PSCs) better simulate the observed total ozone depletions of the past decade than models that include only gas phase reactions. However, they still underestimate the ozone loss by factors ranging from 1.3 to 3.0.

Some unresolved discrepancies between observations and models exist for the partitioning of inorganic chlorine species, which could impact model predictions of ozone trends. These occur for the ClO/HCl ratio in the upper stratosphere and the fraction of HCl to total inorganic chlorine in the lower stratosphere.

Transport of ozone-depleted air from polar regions has the potential to influence ozone concentrations at middle latitudes. While there are uncertainties about the importance of this process relative to *in situ* chemistry for midlatitude ozone, both directly involve ozone destruction by chlorine- and bromine-catalyzed reac-

on satellite data continue to show a long-term cooling trend in global stratospheric temperatures of about 0.3-0.4°C per decade

over the last three decades. Models suggest that ozone depletion is the major contributor to this trend.

Anomalous large downward ozone trends have been observed in midlatitudes of both hemispheres in 1992 and 1993 (i.e., the first two years after the eruption of Mt. Pinatubo), with Northern-Hemispheric decreases larger than those of the Southern Hemisphere. Global-average total-ozone levels in early 1993 were about 1% to 2% below that expected from the long-term trend and the particular phase of the solar and QBO cycles, while peak decreases of about 6-8% from expected ozone levels were seen over 45-60°N. In the first half of 1994, ozone levels returned to values closer to those expected from the long-term trend.

The sulfur gases injected by Mt. Pinatubo led to large enhancements in stratospheric sulfate aerosol surface areas (by a maximum factor of about 30-40 at northern midlatitudes within a year after the eruption), which have subsequently declined.

Anomalous low ozone was measured at altitudes below 25 km at a Northern-Hemispheric midlatitude station in 1992 and 1993 and was correlated with observed enhancements in sulfate-aerosol surface areas, pointing towards a causal link.

Observations indicate that the eruption of Mt. Pinatubo did not significantly increase the HCl content of the stratosphere.

The recent large ozone changes at midlatitudes are highly likely to have been due, at least in part, to the greatly increased sulfate aerosol in the lower stratosphere following Mt. Pinatubo. Observations and laboratory studies have demonstrated the importance of heterogeneous hydrolysis of N_2O_5 on sulfate aerosols in the atmosphere. Evidence suggests that ClONO_2 hydrolysis also occurs on sulfate aerosols under cold conditions. Both processes perturb the chemistry in such a way as to increase ozone loss through coupling with the anthropogenic chlorine and bromine loading of the stratosphere.

Global mean lower stratospheric temperatures showed a marked transitory rise of about 1°C following the eruption of Mt. Pinatubo in 1991, consistent with model calculations. The warming is likely due to absorption of radiation by the aerosols.

Polar Ozone Depletion

In 1992 and 1993, the biggest-ever (areal extent) and deepest-ever (minimum ozone below 100 Dobson units) ozone "holes" were observed in the Antarctic. These extreme ozone depletions may have been due to the chemical perturbations caused by sulfate aerosols from Mt. Pinatubo, acting in addition to the well-recognized chlorine and bromine reactions on polar stratospheric clouds.

Recent results of observational and modeling studies reaffirm the role of anthropogenic halocarbon species in Antarctic ozone depletion. Satellite observations show a strong spatial and temporal correlation of ClO abundances with ozone depletion in the Antarctic vortex. In the Arctic winter, a much smaller ozone loss has been observed. These losses are both consistent with photochemical model calculations constrained with observations from *in situ* and satellite instruments.

Extensive new measurements of HCl, ClO, and ClONO_2 from satellites and *in situ* techniques have confirmed the picture of the chemical processes responsible for chlorine activation in polar regions and the recovery from those processes, strengthening current understanding of the seasonal cycle of ozone depletion in both polar regions.

New laboratory and field studies strengthen the confidence that reactions on sulfate aerosols can activate chlorine under cold conditions, particularly those in the polar regions. Under volcanically perturbed conditions when aerosols are enhanced, these processes also likely contribute to ozone losses at the edges of PSC formation regions (both vertical and horizontal) just outside of the southern vortex and in the Arctic.

Satellite measurements have confirmed that the Arctic vortex is much less denitrified than the Antarctic, which is likely to be an important factor in determining the interhemispheric differences in polar ozone loss.

Interannual variability in the photochemical and dynamical conditions of the vortices limits reliable predictions of future ozone changes in the polar regions, particularly in the Arctic.

Coupling Between Polar Regions and Midlatitudes

Recent satellite observations of long-lived tracers and modeling studies confirm that, above 16 km, air near the center of the polar vortex is substantially isolated from lower latitudes, especially in the Antarctic.

Erosion of the vortex by planetary-wave activity transports air from the vortex-edge region to lower latitudes. Nearly all observational and modeling studies are consistent with a time scale of 3-4 months to replace a substantial fraction of Ant-

arctic vortex air. The importance of this transport to *in situ* chemical effects for midlatitude ozone loss remains poorly known.

Air is readily transported between polar regions and midlatitudes below 16 km. The influence of this transport on midlatitude ozone loss has not been quantified.

Tropospheric Ozone

There is observational evidence that tropospheric ozone (about 10% of the total-column ozone) has increased in the Northern Hemisphere (north of 20°N) over the past three decades. The upward trends are highly regional. They are smaller in the 1980s than in the 1970s and may be slightly negative at some locations. European measurements at surface sites also indicate a doubling in the lower-tropospheric ozone concentrations since earlier this century. At the South Pole, a decrease has been observed since the mid-1980s. Elsewhere in the Southern Hemisphere, there are insufficient data to draw strong inferences.

There is strong evidence that ozone levels in the boundary layer over the populated regions of the Northern Hemisphere are enhanced by more than 50% due to photochemical production from anthropogenic precursors, and that export of ozone from North America is a significant source for the North Atlantic region during summer. It has also been shown that biomass burning is a significant source of ozone (and carbon monoxide) in the tropics during the dry season.

An increase in UV-B radiation (*e.g.*, from stratospheric ozone loss) is expected to decrease tropospheric ozone in the background atmosphere, but, in some cases, it will increase production of ozone in the more polluted regions.

Model calculations predict that a 20% increase in methane concentrations would result in tropospheric ozone increases ranging from 0.5 to 2.5 ppb in the tropics and the northern midlatitude summer, and an increase in the methane residence time to about 14 years (a range of 12-17 years). Although there is a high degree of consistency in the global transport of short-lived tracers within three-dimensional chemical-transport models, and a general agreement in the computation of photochemical rates affecting tropospheric ozone, many processes controlling tropospheric ozone are not adequately represented or tested in the models, hence limiting the accuracy of these results.

Trends in Source Gases Relating to ozone Changes

CFCs, carbon tetrachloride, methyl chloroform, and the halons are major anthropogenic source gases for stratospheric chlorine and bromine, and hence stratospheric ozone destruction. Observations from several monitoring networks worldwide have demonstrated slowdowns in growth rates of these species that are consistent (except for carbon tetrachloride) with expectations based upon recent decreases in emissions. In addition, observations from several sites have revealed accelerating growth rates of the CFC substitutes, HCFC-22, HCFC-141b, and HCFC-142b, as expected from their increasing use.

Methane levels in the atmosphere affect tropospheric and stratospheric ozone levels. Global methane increased by 7% over about the past decade. However, the 1980s were characterized by slower growth rates, dropping from approximately 20 ppb per year in 1980 to about 10 ppb per year by the end of the decade. Methane growth rates slowed dramatically in 1991 and 1992, but the very recent data suggest that they have started to increase in late 1993. The cause(s) of this behavior are not known, but it is probably due to changes in methane sources rather than sinks.

Despite the increased methane levels, the total amount of carbon monoxide in today's atmosphere is less than it was a decade ago. Recent analyses of global carbon monoxide data show that tropospheric levels grew from the early 1980s to about 1987 and have declined from the late 1980s to the present. The cause(s) of this behavior have not been identified.

Consequences of Ozone Changes

The only general circulation model (GCM) simulation to investigate the climatic impacts of observed ozone depletions between 1970 and 1990 supports earlier suggestions that these depletions reduced the model-predicted warming due to well-mixed greenhouse gases by about 20%. This is consistent with radiative forcing calculations.

Model simulations suggest that increases in tropospheric ozone since pre-industrial times may have made significant contributions to the greenhouse forcing of the Earth's climate system, enhancing the current total forcing by about 20% compared to that arising from the changes in the well-mixed greenhouse gases over that period.

Large increases in ultraviolet (UV) radiation have been observed in association with the ozone hole at high southern latitudes. The measured UV enhancements agree well with model calculations.

Clear-sky UV measurements at midlatitude locations in the Southern Hemisphere are significantly larger than at a corresponding site in the Northern Hemisphere, in agreement with expected differences due to ozone column and Sun-Earth separation.

Local increases in UV-B were measured in 1992/93 at mid- and high latitudes in the Northern Hemisphere. The spectral signatures of the enhancements clearly implicate the anomalously low ozone observed in those years, rather than variability of cloud cover or tropospheric pollution. Such correlations add confidence to the ability to link ozone changes to UV-B changes over relatively long time scales.

Increases in clear-sky UV over the period 1979 to 1993 due to observed ozone changes are calculated to be greatest at short wavelengths and at high latitudes. Poleward of 45°, the increases are greatest in the Southern Hemisphere.

Uncertainties in calibration, influence of tropospheric pollution, and difficulties of interpreting data from broad-band instruments continue to preclude the unequivocal identification of long-term UV trends. However, data from two relatively unpolluted sites do appear to show UV increases consistent with observed ozone trends. Given the uncertainties of these studies, it now appears that quantification of the natural (i.e., pre-ozone-reduction) UV baseline has been irrevocably lost at mid- and high latitudes.

Scattering of UV radiation by stratospheric aerosols from the Mt. Pinatubo eruption did not alter total surface-UV levels appreciably.

Related Phenomena and Issues

Methyl Bromide—Three potentially major anthropogenic sources of methyl bromide have been identified: (i) soil fumigation: 20 to 60 ktons per year, where new measurements reaffirm that about 50% (ranging from 20-90%) of the methyl bromide used as a soil fumigant is released into the atmosphere; (ii) biomass burning: 10 to 50 ktons per year; and (iii) the exhaust of automobiles using leaded gasoline: 0.5 to 1.5 ktons per year or 9 to 22 ktons per year (the two studies report emission factors that differ by a factor of more than 10). In addition, the one known major natural source of methyl bromide is oceanic, with emissions of 60 to 160 ktons per year.

Recent measurements have confirmed that there is more methyl bromide in the Northern Hemisphere than in the Southern Hemisphere, with an interhemispheric ratio of 1.3.

There are two known sinks for atmospheric methyl bromide: (i) atmospheric, with a lifetime of 2.0 years (1.5 to 2.5 years); and (ii) oceanic, with an estimated lifetime of 3.7 years (1.5 to 10 years). The overall best estimate for the lifetime of atmospheric methyl bromide is 1.3 years, with a range of 0.8 to 1.7 years. An overall lifetime of less than 0.6 years is thought to be highly unlikely because of constraints imposed by the observed interhemispheric ratio and total known emissions.

The chemistry of bromine-induced stratospheric ozone destruction is now better understood. Laboratory measurements have confirmed the fast rate for the $\text{BrO} + \text{HO}_2$ reaction and have established a negligible reaction pathway producing HBr, both of which imply greater ozone losses due to emissions of compounds containing bromine. Stratospheric measurements show that the abundance of HBr is less than 1 ppt.

Bromine is estimated to be about 50 times more efficient than chlorine in destroying stratospheric ozone on a per-atom basis. The ODP for methyl bromide is calculated to be about 0.6, based on an overall lifetime of 1.3 years. An uncertainty analysis suggests that the ODP is unlikely to be less than 0.3.

Aircraft—Subsonics: Estimates indicate that present subsonic aircraft operations may be significantly increasing trace species (primarily NO_x , sulfur dioxide, and soot) at upper-tropospheric altitudes in the North-Atlantic flight corridor. Models indicate that the NO_x emissions from the current subsonic fleet produce upper-tropospheric ozone increases as much as several percent, maximizing at northern midlatitudes. Since the results of these rather complex models depend critically on NO_x chemistry and since the tropospheric NO_x budget is uncertain, little confidence should be put in these quantitative model results at the present time.

Supersonics: Atmospheric effects of supersonic aircraft depend on the number of aircraft, the altitude of operation, the exhaust emissions, and the background chlorine and aerosol loadings. Projected fleets of supersonic transports would lead to significant changes in trace-species concentrations, especially in the North-Atlantic flight corridor. Two-dimensional model calculations of the impact of a projected fleet (500 aircraft, each emitting 15 grams of NO_x per kilogram of fuel burned at Mach

2.4) in a stratosphere with a chlorine loading of 3.7 ppb, imply additional (i.e., beyond those from halocarbon losses) annual-average ozone column decreases of 0.3-1.8% for the Northern Hemisphere. There are, however, important uncertainties in these model results, especially in the stratosphere below 25 km. The same models fail to reproduce the observed ozone trends in the stratosphere below 25 km between 1980 and 1990. Thus, these models may not be properly including mechanisms that are important in this crucial altitude range.

Climate Effects: Reliable quantitative estimates of the effects of aviation emissions on climate are not yet available. Some initial estimates indicate that the climate effects of ozone changes resulting from subsonic aircraft emissions may be comparable to those resulting from their CO₂ emissions.

Ozone Depletion Potentials (ODPs)—If a substance containing chlorine or bromine decomposes in the stratosphere, it will destroy some ozone. HCFCs have short tropospheric lifetimes, which tends to reduce their impact on stratospheric ozone as compared to CFCs and halons. However, there are substantial differences in ODPs among various substitutes. The steady-state ODPs of substitute compounds considered in the present assessment range from about 0.01-0.1.

Tropospheric degradation products of CFC substitutes will not lead to significant ozone loss in the stratosphere. Those products will not accumulate in the atmosphere and will not significantly influence the ODPs and Global Warming Potentials (GWPs) of the substitutes.

Trifluoroacetic acid, formed in the atmospheric degradation of HFC-134a, HCFC-123, and HCFC-124, will enter into the aqueous environment, where biological, rather than physico-chemical, removal processes may be effective.

It is known that atomic fluorine (F) itself is not an efficient catalyst for ozone loss, and it is concluded that the F-containing fragments from the substitutes (such as CF₃O_x) also have negligible impact on ozone. Therefore, ODPs of HFCs containing the CF₃ group (such as HFC-134a, HFC-23, and HFC-125) are likely to be much less than 0.001.

New laboratory measurements and associated modeling studies have confirmed that perfluorocarbons and sulfur hexafluoride are long-lived in the atmosphere and act as greenhouse gases.

The ODPs for several new compounds, such as HCFC-225ca, HCFC-225cb, and CF₃I, have been evaluated using both semi-empirical and modeling approaches, and are found to be 0.03 or less.

Global Warming Potentials (GWPs)—Both the direct and indirect components of the GWP of methane have been estimated using model calculations. Methane's influence on the hydroxyl radical and the resulting effect on the methane response time lead to substantially longer response times for decay of emissions than OH removal alone, thereby increasing the GWP. In addition, indirect effects including production of tropospheric ozone and stratospheric water vapor were considered and are estimated to range from about 15 to 45% of the total GWP (direct plus indirect) for methane.

GWPs, including indirect effects of ozone depletion, have been estimated for a variety of halocarbons, clarifying the relative radiative roles of ozone-depleting compounds (i.e., CFCs and halons). The net GWPs of halocarbons depend strongly upon the effectiveness of each compound for ozone destruction; the halons are highly likely to have negative net GWPs, while those of the CFCs are likely to be positive over both 20- and 100-year time horizons.

Implications for Policy Formulation

The research findings of the past few years that are summarized above have several major implications as scientific input to governmental, industrial, and other policy decisions regarding human-influenced substances that lead to depletion of the stratospheric ozone layer and to changes of the radiative forcing of the climate system:

The Montreal Protocol and its Amendments and Adjustments are reducing the impact of anthropogenic halocarbons on the ozone layer and should eventually eliminate this ozone depletion. Based on assumed compliance with the amended Montreal Protocol (Copenhagen, 1992) by all nations, the stratospheric chlorine abundances will continue to grow from their current levels (3.6 ppb) to a peak of about 3.8 ppb around the turn of the century. The future total bromine loading will depend upon choices made regarding future human production and emissions of methyl bromide. After around the turn of the century, the levels of stratospheric chlorine and bromine will begin a decrease that will continue into the 21st and 22nd centuries. The rate of decline is dictated by the long residence times of the CFCs, carbon tetrachloride, and halons. Global ozone losses and the Antarctic ozone "hole" were first discernible in the late 1970s and are predicted to recover in about the year 2045,

other things being equal. The recovery of the ozone layer would have been impossible without the Amendments and Adjustments to the original Protocol (*Montreal, 1987*).

Peak global ozone losses are expected to occur during the next several years. The ozone layer will be most affected by human-influenced perturbations and susceptible to natural variations in the period around the year 1998, since the peak stratospheric chlorine and bromine abundances are expected to occur then. Based on extrapolation of current trends, observations suggest that the maximum ozone loss, relative to the late 1960s, will likely be: (i) about 12-13% at Northern midlatitudes in winter/spring (i.e., about 2.5% above current levels); (ii) about 6-7% at Northern midlatitudes in summer/fall (i.e., about 1.5% above current levels); and (iii) about 11% (with less certainty) at Southern midlatitudes on a year-round basis (i.e., about 2.5% above current levels).

Such changes would be accompanied by 15%, 8%, and 13% increases, respectively, in surface erythemal radiation, if other influences such as clouds remain constant. Moreover, if there were to be a major volcanic eruption like that of Mt. Pinatubo, or if an extremely cold and persistent Arctic winter were to occur, then the ozone losses and UV increases could be larger in individual years.

Approaches to lowering stratospheric chlorine and bromine abundances are limited. Further controls on ozone-depleting substances would not be expected to significantly change the timing or the magnitude of the peak stratospheric halocarbon abundances and hence peak ozone loss. However, there are four approaches that would steepen the initial fall from the peak halocarbon levels in the early decades of the next century: (i) If emissions of methyl bromide from agricultural, structural, and industrial activities were to be eliminated in the year 2001, then the integrated effective future chlorine loading above the 1980 level (which is related to the cumulative future loss of ozone) is predicted to be 13% less over the next 50 years relative to full compliance to the Amendments and Adjustments to the Protocol. (ii) If emissions of HCFCs were to be totally eliminated by the year 2004, then the integrated effective future chlorine loading above the 1980 level is predicted to be 5% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol. (iii) If halons presently contained in existing equipment were never released to the atmosphere, then the integrated effective future chlorine loading above the 1980 level is predicted to be 10% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol. (iv) If CFCs presently contained in existing equipment were never released to the atmosphere, then the integrated effective future chlorine loading above the 1980 level is predicted to be 3% less over the next 50 years relative to full compliance with the Amendments and Adjustments to the Protocol.

Failure to adhere to the international agreements will delay recovery of the ozone layer. If there were to be additional production of CFCs at 20% of 1992 levels for each year through 2002 and ramped to zero by 2005 (beyond that allowed for countries operating under Article 5 of the Montreal Protocol), then the integrated effective future chlorine loading above the 1980 level is predicted to be 9% more over the next 50 years relative to full compliance to the Amendments and Adjustments to the Protocol.

Many of the substitutes for the CFCs and halons are also notable greenhouse gases. Several CFC and halon substitutes are not addressed under the Montreal Protocol (because they do not deplete ozone), but, because they are greenhouse gases, fall under the purview of the Framework Convention on Climate Change. There is a wide range of values for the Global Warming Potentials (GWPs) of the HFCs (150-10000), with about half of them having values comparable to the ozone-depleting compounds they replace. The perfluorinated compounds, some of which are being considered as substitutes, have very large GWPs (e.g., 5000-10000). These are examples of compounds whose current atmospheric abundances are relatively small, but are increasing or could increase in the future.

Consideration of the ozone change will be one necessary ingredient in understanding climate change. The extent of our ability to attribute any climate change to specific causes will likely prove to be important scientific input to decisions regarding predicted human-induced influences on the climate system. Changes in ozone since pre-industrial times as a result of human activity are believed to have been a significant influence on radiative forcing; this human influence is expected to continue into the foreseeable future.

Mr. BARTON. Thank you, Dr. Watson.

We would now like to hear from Dr. Singer and again your statement is submitted for the record. We would hope you could summarize it in approximately 5 minutes. Thank you, sir.

TESTIMONY OF S. FRED SINGER

Mr. SINGER. Thank you. Mr. Chairman, ladies and gentlemen, I feel it necessary to say something about my personal background in this field in view of some of the statements that Mr. Watson has made.

I've been involved in the ozone issue and space atmospheric physics for over 40 years. I established the U.S. Weather Satellite Service in 1962 and served as the first director; devised the instrument that's used to measure ozone from satellites.

When I was at EPA, I chaired an interdepartmental panel that looked into the effects of supersonic transports on stratospheric ozone including the health consequences like skin cancer.

And more recently, I was chief scientist of the Department of Transportation and advised the White House science adviser on the issue of effects of ozone.

My testimony was to summarize the current status of the science and strongly point out my disagreements with Robert Watson's statement and the assessment that he has referred to.

Then I want to state very clearly that there is no scientific consensus on this issue. I'm flattered to be considered a minority of one, but I can assure you, ladies and gentlemen, that there are a large number of scientists who disagree with specific aspects of the so-called scientific assessment. In fact, in Mr. Watson's testimony he refers to the fact that a very large majority agrees with the assessment, but he doesn't say anything about the minority of scientists who worked on the assessment who disagree with it. I think it would be interesting to find out something about this.

I then wanted to show that the Montreal Protocol which was concluded in 1987 was negotiated without any adequate concern for scientific evidence and then finally I want to point out why it makes no scientific sense at this time to phase out methyl bromide.

The bottom line of my scientific summary is this. The currently available scientific evidence does not support the ban on these various halocarbons; that is, the chlorofluorocarbons, halons, and especially methyl bromide. Certainly, there is no justification for the accelerated phaseout that was instituted in 1992, based on nothing more than a highly questionable press conference held by NASA.

In fact, the whole history of the CFC ozone issue is filled with selective use of data, faulty application of statistics, disregard of any contrary scientific evidence and other scientific distortions. We've had such things as EPA's estimate in 1987 that there would be 3 million additional skin cancer deaths. That estimate is widely off the mark but it has never been retracted.

We've had scare stories about blind sheep in Chile, about the disappearance of frogs worldwide, about plankton death, and all sorts of unimaginable and unspeakable disasters. This has all been passed along to the public by uncritical news media.

Now, there is a hypothesis that CFCs deplete ozone and it is that, it is a hypothesis. I point out to you that the theory did not predict the Antarctic ozone hole, which is genuine, and the theory

still cannot predict what will happen in the future because the theory is not adequate to do that.

I don't believe that there's any firm evidence for any long-term depletion of ozone. Ozone varies naturally over many time scales with great, great percentages and it is very difficult to extract a long-term trend from a short time record because all we have is a very short time record. In the case of satellites, our time records extends only over about 15 years, which is just a little more than the solar cycle. The solar cycle is 11 years which is one of the major cycles for ozone variation.

As Watson has admitted, there's no evidence for an upward trend in ultraviolet, no evidence at all for an upward trend. I think he puts it very well in his testimony and I'd like to read it. He says, "Various factors have precluded the unequivocal identification of a long-term trend in surface UV." I think that means that there's no evidence for an upward trend.

And finally and I think most important, the only laboratory experiments we now have about malignant melanoma have established that malignant melanoma, which is the deadly form of skin cancer that people are really worried about, is caused not by UV-B, the UV which is absorbed by ozone, but by UV-A, invisible which is not absorbed by ozone. And this probably explains why melanoma does not show any particular dependence on latitude. In fact, in Europe, the dependence, according to a Science Magazine, goes the other way.

Melanoma, in other words, has been increasing since 1935 by large amounts, long before there was any talk about ozone depletion and long before CFCs came into use. And it's clear that it is related to life-style changes and people's exposure to UV-A and sunlight generally.

A few words about the scientific consensus. It's always brought out whenever there is no evidence to demonstrate, no scientific evidence to demonstrate a particular point. The scientific consensus, that's a political concept, not a scientific concept. Scientific truth is never arrived at by a show of hands. Every advance in science has come from an idea that did not conform to prevailing opinion.

You may recall that the consensus had it at one time that the earth was flat, that the sun revolved around the earth, and the atom couldn't be split. Consensus has been blamed also for the global warming issue. The official report of a U.N.-sponsored inter-governmental panel on climate change mentions, however, the existence of minority views, right in the report. But then the editors say they couldn't accommodate these minority views. I think it would be interesting to know how many disagreed and why they couldn't accommodate them. So there is no scientific consensus.

I would now like to turn to my second point, the Montreal Protocol.

Mr. BARTON. Could you summarize your second and last point in about 30 seconds to a minute? We've given you extra time since we gave Dr. Watson extra time, but we have one more panel.

Mr. SINGER. Yes. I would just like to point you to a book published by the chief U.S. negotiator, Richard Benedict. In his book, "Ozone Diplomacy," he says, "Perhaps the most extraordinary aspect of the Montreal Treaty was its imposition of substantial short-

term economic costs against unproved future dangers, dangers that rested on scientific theories, rather than on firm data." Finally, my third point, why phasing out methyl bromide makes no sense. You've already heard that most of methyl bromide comes from natural sources. You've also heard from Dr. Watson that methyl bromide has a very short lifetime, a year, maybe less. This means that if methyl bromide ever does cause a problem, we can move rapidly to do something about it, unlike CFCs.

I would like to give you one sort—

Mr. BARTON. Dr. Singer, we'll take the rest of your statement for the record, but we can't let you speak twice as long as Mr. Watson. Even though I tend to agree more with you than with him, I have to be fair in the presentation.

Mr. SINGER. I will try to give you my comments and conclusions in answer to some question.

[The prepared statement of S. Fred Singer follows:]

PREPARED STATEMENT OF S. FRED SINGER, PRESIDENT, THE SCIENCE &
ENVIRONMENTAL POLICY PROJECT

Mr. Chairman, Ladies and Gentlemen, My name is S. Fred Singer. I am professor emeritus of environmental sciences at the University of Virginia and the founder and president of The Science & Environmental Policy Project in Fairfax, Virginia.

My Relevant Background

I hold a degree in engineering and a Ph.D. in physics. I have specialized in atmospheric and space physics. My professional career includes the early design of satellites, for which I received a Special Commendation from President Eisenhower. I established the U.S. Weather Satellite Service in 1962, was its first director, and received a Gold Medal award from the Dept. of Commerce. I devised the instrument that is currently used to measure stratospheric ozone from satellites.

As a Deputy Assistant Administrator of the U.S. Environmental Protection Agency in 1971, I chaired an interdepartmental panel of scientists looking into the possible effects of a proposed fleet of supersonic transports (SSTs) on stratospheric ozone. Ours was the first group to examine the issue of possible damage to the ozone layer and its health consequences, including skin cancers. During the 1980s, while serving as Chief Scientist of the Department of Transportation, I provided expert advice to the White House Science Adviser on the effects of man-made substances on the ozone layer.

Outline of Testimony

This morning I would like to review with you very briefly the current status of the science, mentioning a scenario that does not accord with current control policy, and then touch on three topics: First, I want to state clearly that there is no scientific consensus on ozone depletion or its consequences. Next, I want the record to show that the 1987 Montreal Protocol [on Substances that Deplete the Ozone Layer] was negotiated without adequate concern for scientific evidence. Finally, I want to comment on why it makes no scientific sense at this time to phase out methyl bromide.

Scientific Summary

The bottom line is this: Currently available scientific evidence does not support a ban on the production of chlorofluorocarbons (CFCs or Freons), halons, and especially methyl bromide. There certainly is no justification for the accelerated phase-out of CFCs, which was instituted in 1992 on nothing more than a highly questionable NASA press conference.

In fact, the history of the CFC-Ozone depletion issue is rife with selective use of data, faulty application of statistics, disregard of contrary evidence, and other scientific distortions. The policy before and since the Montreal Protocol has been driven by wild and irresponsible scare stories: EPA's estimate of 3 million additional skin cancer deaths, blind sheep in Chile, plankton death, the disappearance of frogs—all passed along to the public by an uncritical news media.

The hypothesis that CFCs deplete ozone is still just that: a hypothesis. The theory did not predict the Antarctic ozone hole and cannot predict what will happen globally. There is no firm evidence as yet for a long-term depletion of global ozone. Much

of data is contaminated; the ozone record is dominated by large, natural fluctuations on many time scales; and there are even long-term changes of natural origin extending over decades. In spite of what you may have read, there is no credible evidence for a long-term increase of ultraviolet radiation at the earth's surface—as a result of a depletion of ozone. And finally, laboratory experiments have now established that malignant melanoma, the deadly form of skin cancer, may be caused by a band of ultraviolet radiation that is not absorbed by ozone at all.

A Different Scenario

Are halocarbons, like CFCs, really the major culprit when it comes to ozone damage? Let me give you a very different scenario, but one which is also scientifically plausible. We saw the Antarctic ozone hole grow in size and extent quite suddenly between about 1978 and 1983. We know now that this phenomenon depends not only on the presence of chlorine—coming from natural and man-made sources—but in a crucial way also on the presence of ice crystals. These form when the humidity is high enough and the temperature low enough. The role of ice crystals as a catalyst was not predicted by the CFC-ozone depletion theory. Two researchers with the National Oceanographic and Atmospheric Administration earlier this year published evidence that stratospheric water vapor has been increasing for some time. I believe that the most likely source of the additional water vapor is methane gas added to the earth's atmosphere by human-related sources like cattle raising and rice growing, and natural sources like wetlands. Methane is, in fact, increasing in the earth's atmosphere, as I had predicted in 1971. We also know that the global stratosphere is cooling, probably as a result of the increase in carbon dioxide. It is quite possible, therefore, that the controlling factors in the creation of an ozone hole in the Antarctic—and potentially elsewhere—are methane and carbon dioxide rather than the growth in CFCs. If this is so, then ozone holes would persist, even in the absence of CFCs, because of the existing natural sources of chlorine.

For backup and more detail I refer you to numerous publications. Some are attached to my testimony and I ask that they be entered into the record.

Scientific Consensus?

The argument put forth constantly in trying to substantiate ozone depletion is the notion of a scientific consensus. But "consensus" is a political concept, not a scientific one. Scientific truth is never arrived at by a show of hands; every advance has come from controversy. At one time there was "consensus" that the earth was flat, that the sun revolved around the earth, that the atom could not be split. More recently, consensus was claimed for the global warming issue. Yet the official report from the UN Intergovernmental Panel on Climate Change specifically mentions the existence of "minority" views that the editors could not, or perhaps would not, "accommodate."

During the summer of 1991, the Science & Environmental Policy Project surveyed a substantial number of IPCC contributors and reviewers. About half of the respondents said that the IPCC Summary did not reflect their views and might convey a misleading message to policymakers. Unfortunately, we have not had an opportunity to carry out a similar survey of the scientists associated with the UN Ozone Assessment.

The Montreal Protocol Was Founded on Theoretical Speculation, not Firm Data

Turning to the matter of scientific support for the Montreal Protocol, we have the statements of the chief U.S. negotiator, State Department official Richard Benedick. In his book, *Ozone Diplomacy*, on page 2, we read: "Perhaps the most extraordinary aspect of the treaty was its imposition of substantial short-term economic costs...against unproved future dangers—dangers that rested on scientific theories rather than on firm data."

Again, on page 18: "In July 1987, practically on the eve of the final negotiating session in Montreal, NOAA concluded that the 'scientific community is currently divided as to whether existing data on ozone trends provides sufficient evidence...that a chlorine-induced ozone destruction is occurring.'" And further: "Writing in 1989, [Prof] Sherwood Rowland, [an originator of the CFC-ozone theory and fervent advocate of a ban on CFCs,] observed that 'statistical evaluation through 1986 gave no indication of any trend in global ozone significantly different from no change at all.'"

Benedick does not mention the fact that, as late as 1988, published information on stratospheric chlorine showed no upward trend, thus indicating that neither CFCs nor other manmade chemicals were contributing significantly to the known natural sources, like volcanoes and oceans. An article by MIT professor Ronald Prinn in a book edited by Rowland, and published in 1988, makes this point quite clear.

It is evident from the above quotes that the negotiators and their scientific supporters were not the least bit inhibited by the absence of scientific information—or indeed by the presence of contrary information. To quote Benedick again, the negotiators were quite aware of the “very real short-run economic dislocations” but viewed the whole matter as an “unusual challenge to diplomacy”. Indeed, the 1987 Montreal Protocol was to become the first example of an international treaty controlling the production and release of a manmade chemical.

Phasing Out Methyl Bromide Makes No Sense

Phasing out CFCs on an accelerated schedule would be bad enough, but a ban on methyl bromide makes absolutely no sense at this stage. There are at least three scientific arguments: (1) Unlike CFCs, which do contribute to stratospheric chlorine—along with many natural sources—we have no evidence that bromine or any of its compounds are increasing in the stratosphere. This is not surprising; bromine can hardly even be measured. (2) Unlike CFCs, methyl bromide enters the atmosphere mostly from natural sources in the world's oceans. (3) Finally, methyl bromide has an atmospheric lifetime of only a year, while CFCs survive for a century. In other words, if methyl bromide were ever found to cause a problem, it would disappear from the atmosphere one year after its production is stopped.

A Common-Sense Conclusion

Let's put the whole issue in perspective. Promoters of the ozone-CFC theory are projecting about 5 percent depletion. This would create a 10 percent increase in surface ultraviolet radiation—on a clear day. But UV naturally increases by some 5,000 percent from the poles to the equator because of the steepening angle of the sun. Therefore the projected UV increase from a worst-case global ozone depletion—the basis for all of these scare stories and an international policy that will conservatively cost the U.S. economy alone some \$100 billion dollars—can be experienced right now by moving just 60 miles closer to the equator, from Washington to Richmond.

The scare stories don't pass what I call the common-sense test. New Yorkers moving to Florida experience a more than 200 percent increase in UV. Why aren't they dropping like flies? Mail-order nurseries in the upper mid-west ship field-grown plants all over the United States. Why don't these plants die?

Promoters of the CFC-ozone depletion theory have insisted that governments must do something—even without scientific evidence—because if we don't do something now it will be too late. I disagree. If we don't know the extent of the problem—or even if it exists at all—then we cannot be sure that what we are doing will have any effect. We are flying blind on this issue—at a huge cost to the economy and ultimately to every household.

Mr. BARTON. Thank you, sir.

The Chair would recognize himself for the first 5 minutes of questions. And I will ask this to both of you, because I'm not a scientist, but it would appear to me that if methyl bromide is the problem, the causal agent in ozone depletion, that where we most use methyl bromide would be where we most see the problem, i.e., in Florida and California and Texas and the regions that use it for agricultural purposes.

Why is it that where we most see the lack of ozone or the hole in the ozone layer is where there's little human habitation or no human habitation?

Mr. WATSON. Fluorocarbons and any of the middle- to long-lived gases are uniformly distributed over the globe. It doesn't actually matter if you put the CFCs or the bromine compounds all in New York or all in Chile. After a few years, they are uniformly distributed to a first approximation over the whole globe. They penetrate to the stratosphere through transport mechanisms that typically takes 2 to 5 years and then they become uniformly distributed over the stratosphere, globally over the stratosphere.

The reason why we see the very large hole in Antarctica is very unique meteorological conditions. They track over Antarctica. It becomes very cold. All the water in the stratosphere becomes ice crys-

tals and effectively changes the chlorine and bromine chemistry, hence chlorine and bromine are much, much more efficient at destroying ozone over Antarctica than any other part of the world.

So the reason you see the ozone hole is basically unusual chemistry and unusual meteorology in Antarctica and to some degree over the Arctic. But there is no real puzzle why it is not over Florida and why it's not over California. These gases spread out.

Mr. SINGER. I agree with his analysis. I would like to remark that the presence of ice crystals in Antarctica is crucial. To make ice crystals, you need low temperature and you need water vapor. I would like to point out that the temperature of the stratosphere has been decreasing as the result of the emission of carbon dioxide by human activities and the humidity of the stratosphere has been going up, as has just been measured, probably as a result of the creation of extra methane by human activities.

In other words, it is plausible to me at least that human activities are playing a role in the Antarctic, but not because of increasing chlorine, but because of increases in ice crystals due to lower temperatures and higher water vapor content.

Mr. BARTON. My next question goes about the lack of scientific evidence that indicates the problem. My staff tells me that here in Washington, DC, that the ozone varies seasonally as much as 20 percent, so I think each of you gentlemen have indicated that the largest cause of these gases are from natural causes. So if that is a true statement, are we not premature in banning a substance that has such beneficial uses in agriculture since we really can't show that that is causing the problem?

Mr. SINGER. The natural variations of ozone are indeed very large. Here in Washington or mid latitudes the day-to-day variations can be as large as 100 percent, averaged over our latitude around the globe. The seasonal variation is on the order of 50 percent during the season. That's a very large variation.

We have even variations over an 11-year solar cycle, the sunspot cycle, which show a few percent and the problem is that these variations are not predictable. They depend on sun spots which are not predictable either. And therefore it is extremely difficult, I believe, to extract a long-term trend by analyzing the short amount of data, the short period of data that we have now.

Mr. BARTON. Dr. Watson, would you like to respond to that?

Mr. WATSON. Yes. To the satellite data is only 15 years, the ground-based data a large amount goes back to 1960, the IGY 1958, and so you actually can look at a 35-year record not just a decadal record. Ozone is quite variable, but society has adapted to the average conditions. It's like saying temperature varies by 100 degrees in Washington, DC, from the 100 degrees we've got now to zero degrees in December. Yet what we care about is often average conditions in a season.

So what we care about for ozone is the average amount of ozone, so although there's wild fluctuations day to day it's the average level that you care about that effectively threatens us for skin cancer and threatens ecological systems.

Mr. BARTON. And your hypothesis is that the average level of ozone is trending down.

Mr. WATSON. There is absolutely no question based on both satellite data and ground-based data, both European data, American data. Russian data is a totally different system. At first, when we put this out in the ozone trends report in the late 1980's many people were skeptical. The most skeptical were industry and I put a couple of their very best statisticians on this and they confirmed exactly the same results as we came up to.

At that particular time the Soviet Union also thought that the ozone issue was a nonissue. They effectively totally reanalyzed all of their data and came up with the same conclusions. So when I talk about consensus report, these are people that come to the table with very, very different viewpoints. Places like Allied and DuPont have analyzed this data and come to the same conclusions. The Russians have come to the same conclusion using very different data sets.

Mr. BARTON. My time is expired. I recognize Mr. Wyden.

Mr. WYDEN. Thank you, Mr. Chairman.

Dr. Singer, the latest scientific assessment contains references to thousands of scientific papers across a broad range of issues related to ozone depletion and its effects.

Are there any references to your work in this latest scientific assessment?

Mr. SINGER. I have not checked this, but I've had several papers published or several articles that are published in the scientific literature in the last 3 years. But as I mentioned earlier, there has been, unfortunately, a selective use of data throughout this whole business and that's regrettable. From purely a scientific point of view, you should not ignore people's work if it disagrees with your preconceived notions.

Mr. WYDEN. Well, as I say, I don't have any preconceived notions.

Mr. SINGER. I wasn't accusing you.

Mr. WYDEN. We have got lots of growers and my understanding is that there weren't any references to your work in this latest scientific assessment, but I think it would be very helpful if you could furnish for the record any peer-reviewed articles that you have authored over the last 5 or 6 years, take a reasonable period of time.

Mr. SINGER. I would be more than happy to do that.

Mr. WYDEN. Very good.

[The information referred to follows:]

THE SCIENCE & ENVIRONMENTAL POLICY PROJECT,
Fairfax, VA,
October 27, 1995.

The Honorable JOE BARTON,
Chairman, Subcommittee on Oversight and Investigations,
Room 2125, Rayburn House Office Building,
Washington, DC.

DEAR MR. BARTON: I am pleased to respond to your letter of October 10 and provide the three items of information you requested in connection with my testimony of August 1. I also wish to comment on the cost-benefit figures presented by the EPA witness Mary Nichols.

1. *Scientific publications*: I have published well over 150 scientific articles in peer-reviewed journals, many of which are listed below. A number of these articles are relevant to the atmospheric ozone issue; they are referenced in the summary article in the *Journal of the Franklin Institute*, submitted with my testimony.

Journal of the Franklin Institute, Physical Review, Physical Review Letters, Reviews of Geophysics, Journal of Geophysical Research, Transactions of the American Geophysical Union, Astrophysical Journal, Physics of Fluids, Icarus, Environmental Geology, Environmental Conservation, Environmental Science and Technology, Meteorology and Atmospheric Physics, Science, Nature. This is not a complete list; there may also be others.

2. *Methyl Bromide*: The most recent scientific summary on MeBr is the attached article by Dr. James H. Butler, which appeared in *Nature* (Vol. 376, pp. 469-470, 10 August 1995). "Methyl Bromide Under Scrutiny" summarizes a workshop held in June 1995. As can be readily seen, the Butler article confirms my August 1 testimony. Because its atmospheric "lifetime" is only about one-year—compared to decades for CFCs—the "precautionary principle" does not apply to MeBr, its atmospheric burden could be reduced within a few years if there should ever be a problem.

An important global source of MeBr is bio-mass burning, most of it human-related. But the ocean is both the largest source and the second-largest sink.

While uncertainties in stratospheric MeBr measurements are still very large, we may state that abundances there are lower by a factor of three or four than calculated. And finally, there is no evidence whatsoever for an upward trend (to indicate that human sources are more important than natural sources).

3. *Solar ultraviolet radiation getting to the Earth's surface*: UV-B covers the wavelength region of 280 to 320 nanometers and is absorbed by ozone—strongly at 280 and weakly at the long wavelength end. By the time we reach the UV-A region, covering wavelengths of 320 to 400nm, the absorption by ozone is essentially zero.

There have been two major changes in our view about skin cancer incidence. Whereas EPA had assumed that 100% of all malignant melanomas are due to UV-B, the Setlow experiments suggests that 90-95% are due to UV-A and therefore *unaffected* by any change in the thickness of the ozone layer. This reduces the EPA mortality figures by a factor of 10 to 20!

When it comes to non-melanoma skin cancers (NMSC), there is agreement that these generally non-lethal cancers are produced by UV-B. The EPA assumes that a 1% increase in UV-B radiation would lead to a 2% increase in the incidence of NMSC. This is again an overestimate by perhaps a factor of ten—for the following reasons:

The EPA numbers are derived by noting that the incidence of NMSC is 5 times greater in Albuquerque than in Seattle, while calculated (clear-sky) UV intensity increases by a factor of 2.5. But one cannot simply relate the ratio of skin cancers to the ratio of UV-B. EPA's high ratio of 2:1 hides two unjustified assumptions: (i) that the fraction of clear days in Seattle is equal to that in Albuquerque, and (ii) that people in Albuquerque walk in raincoats rather than short-sleeved shirts and typically get no more body exposure per day than people in Seattle. When these two assumptions are allowed for, the skin cancer-to-UV ratio may well drop by a large factor. Additionally, in deriving its mortality figures, EPA assumes that people's future behavior will not change: i.e., (i) people will not learn to protect themselves from the sun; and (ii) people will not seek medical treatment for skin cancer.

4. *EPA cost-benefit analyses*: EPA witness Mary Nichols quoted benefit numbers (for avoiding a hypothetical ozone depletion) of up to \$32 trillion (!) and benefit-cost ratios of 1000! No backup was presented for these truly amazing numbers—which should be subjected to scrutiny by appropriate experts.

Thank you for giving me the opportunity to amplify my testimony. I will be pleased to provide any further information.

Sincerely yours,

S. FRED SINGER.

COMMENTS ON TESTIMONY OF DR. ROBERT WATSON, WHITE HOUSE AND MARY NICHOLS, EPA, BY S. FRED SINGER

"Scientific Consensus"?

Watson's testimony reflects the conclusions of the 1994 "Scientific Assessment of Ozone Depletion". According to Watson (p. 1), this "represents the views of the *very large majority* of the international scientific community". This raises the interesting question, "What about the minority views?" They are not identified in the assessment report, nor is there any indication of even their existence. We must therefore conclude that these views have been disregarded by the editors of the Assessment, i.e. Watson et al. This of course diminishes the credibility of the Assessment Report.

Similarly, the 1990 report of the IPPC on Climate Change has been referred to as representing a "scientific consensus". But the foreword of the report specifically mentions the existence of minority views. Again, they are nowhere identified. The editors state that the report "was not able to accommodate them".

In the case of the IPPC report, the SEPP surveyed more than 100 IPPC contributors and reviewers during the summer of 1991. Only about half of the respondents thought that the Policymakers Summary reflected the text of the report accurately; a majority said that the Summary did not reflect their own views and might convey a misleading message to policymakers.

Dr. Watson has been an organizer, editor, and main U.S. representative for both the ozone and climate change reports. Since he well knows and admits of the existence of minority views, it is amusing that he refers to me in his oral testimony as a "minority of one". In this he echoes the frequent references by Vice President Al Gore to a "tiny minority of scientists".

UV Increases?: Playing with Words

Both Watson and Nichols are careless with words. By using terms imprecisely they convey misleading impressions. For example, both refer to observed "increases in UV-B radiation". Such increases should not be confused however with a long-term upward *trend* which has *not* been observed. UV-B will increase whenever there is a downward fluctuation in ozone; but then UV-B will decrease when ozone recovers. In other words, there is no evidence for a long-term trend.

A similar confusion is introduced with the term "stratospheric ozone depletion." EPA's Office of Research and Development published a pamphlet with this title in March of 1995. In spite of this, nowhere in the pamphlet is there any evidence given for long-term ozone depletion trend. The only statement relating to it can be found on page 5: "Stratospheric ozone levels fluctuate periodically. Under some circumstances, the fluctuations are extreme."

A particular amusing example of circumlocution is found on page 3 of Watson's testimony. He mentions factors that have "precluded the unequivocal identification of a long-term trend in surface UV radiation." What he means to say, of course, is that he has no evidence for such a trend. Nor is there evidence for long-term trends of stratospheric bromine. Evidence for long-term trends in ozone depletion is a contested issue that must be resolved by more observations.

An interesting point raised by Nichols is that ozone depletion will increase surface smog by allowing more UV to penetrate. If this is true, will this surface smog not also screen people from UV-B?

Skin Cancers: Playing with Words

Another example of misuse of words is referring to "skin cancer" without making the important distinction between nonmalignant basal—and squamous-cell skin tumors, and malignant melanoma, which is deadly. For example, when Nichols refers to UV-B effects on skin cancer she is not referring to malignant melanoma but instead to the nonmalignant variety.

This distinction is particularly important in view of her extraordinary claim that the benefits of a CFC phase-out exceed cost by a factor of more than 1000 to 1. She presents an estimate of public health benefits of between \$8 and \$32 trillion! It would seem important to inquire as to what assumptions have gone into this remarkable estimate.

CHEMICAL & ENGINEERING NEWS

[November 27, 1995]

Response to 'facts'

In response to Madeleine Jacobs' editorial "Don't Confuse Me with the Facts" (C&EN, Oct. 9, page 5), I present some facts related to my September 20 congressional testimony.

Contrary to the "UN Scientific Assessment of Ozone Depletion: 1994," evidence from ground stations and satellites for a long-term ozone depletion trend is not yet compelling. The assessment does not squarely address problems of data contamination and instrument calibration.¹ A separate issue—inadequately discussed—is the shortness of the global record, in some cases barely more than one sunspot cycle.²

There is no credible evidence for a long-term upward trend of solar ultraviolet radiation at Earth's surface. The widely publicized claim for such a trend³ is acknowledged to be spurious and based on a faulty statistical analysis.⁴

How does chlorine destroy ozone molecules in the lower stratosphere, where most ozone exists? Important clues are provided by the Antarctic ozone hole and the ozone depletion caused by the Mount Pinatubo eruption in the Philippines. Both in-

dicating that the presence of particles is essential⁵—something not anticipated or predicted by the Rowland-Molina theory.

Another clue comes from the absence of ozone destruction in the middle stratosphere,⁶ which suggests that global ozone depletion—once it is established beyond doubt—may be related to increasing levels of stratospheric sulfate aerosols.⁷

Moreover, both theory⁸ and observations⁹ provide evidence that radicals derived from water vapor are the most effective ozone destroyers in the lower stratosphere. And water vapor radicals may be rate limiting.

Stratospheric water vapor is rising, probably due to increased methane production from human activities.¹¹ Could man-made sources of methane—cattle raising and rice growing, for example—be more damaging to the ozone layer than chlorofluorocarbons?

These questions need to be debated before far-reaching policies that would waste upward of \$100 billion are put into effect. The award of a Nobel Prize cannot take the place of valid data and sound analysis.

S. FRED SINGER,
President, Science & Environmental Policy Project,
Fairfax, VA.

¹ S.F. Singer "Ozone Depletion", *Chem & Engr News* 71 (28), 2 (12 July 1993);—"Ozone Depletion Theory", *Science* 261, 1101-2 (1993).

² *Scientific Assessment of Ozone Depletion: 1994* WMO Report No. 37, p. 1.14 and p. 1.19.

³ J.B. Kerr and C.T. McElroy, "Evidence for Large Upward Trends of Ultraviolet-B Radiation Linked to Ozone Depletion," *Science* 262, 1032-1034 (1993)

⁴ P.J. Michaels, S.F. Singer, P.C. Knappenberger, "Analyzing Ultraviolet-B radiation: Is there a trend?" *Science* 264, 1341-2 (1994)

⁵ *Scientific Assessment*, pp. 3.10-3.27.

⁶ *Scientific Assessment*, p. 1.37.

⁷ D.J. Hofmann, "Increase in the Stratospheric Background Sulfuric Acid Aerosol Mass in the Past 10 Years," *Science* 248, 996-1000 (1990).

⁸ P.O. Wennberg et al., "Removal of Stratospheric O₃ by Radicals: In Situ Measurements of OH, HO₂, NO, NO₂, ClO, and BrO," *Science* 266, 398-404 (1994).

⁹ S.J. Oltmans and P.J. Hofmann, "Increase in Stratospheric Water Vapor at a Midlatitude Northern Hemisphere Site from 1981-1994," *Nature* 374, 146-140 (1995).

¹¹ S.F. Singer, "Stratospheric Water Vapour Increase Due to Human Activities," *Nature* 223, 543-547 (1971); *Scientific Assessment*, p. xxii.

Mr. SINGER. I'd like to point out, however, that there is a peer-reviewed paper by two Belgian scientists in the *Journal of Geophysical Research* that throws great doubt on the so-called consensus about a depletion of ozone. The title of the paper contains the word, "fictitious." It calls the depletion fictitious. And it points out that the data that had been measured since these international geophysical years since 1960, as Dr. Watson points out, had been contaminated.

These are contaminated data, contaminated by the presence of sulfur dioxide in the atmosphere. Unfortunately, sulfur dioxide affects the instrument, the ozone instrument in the same way as ozone. You can't tell the difference in the instrument, from the instrument which one is measuring—

Mr. WYDEN. My time is short and no one is accusing you of fictions and contaminations and the like. If you could furnish us your peer-reviewed articles, that would be helpful.

My last question deals with the fact with you two obviously having a dramatic difference of opinion with respect to the nature and extent of the ozone hole problem, why don't each one of you, just so we are clear, point to the key piece of scientific evidence that supports your point of view?

We will take you, Dr. Watson, what you think is the key point of scientific evidence that points to your position, and you, Dr. Singer, the key evidence that supports your position.

Mr. WATSON. I believe two pieces. One, I believe the statistical analysis of both the ground-based and satellite data definitively

shows ozone depletion has occurred and is occurring, and effects such as sulfur dioxide have been taken into account.

Second, the aircraft measurements and ground-based measurements that look at the chemistry directly in the stratosphere, the key chlorine and bromine species that react to ozone, you combine those observations with theoretical models and you basically get a picture that makes sense. And that's really the conclusion of all of these people. Ozone depletion is occurring when we go and measure the chlorine- and bromine-containing species and you compare it with theoretical observations, it makes a consistent picture.

Mr. WYDEN. Same question, Dr. Singer.

Mr. SINGER. Thank you. The statistical analysis of ozone has been carried out, but when you examine it in detail, it turns out that the depletion trend depends on what time limit will you choose for examination. It depends on when you start and when you stop. If the trend were truly as advertised, this should not happen.

Second, the so-called upwards trend of ultraviolet which has been claimed in the published literature has turned out to be spurious and based on the faulty application of statistical analysis. And that has been demonstrated in a paper published in Science Magazine.

Third, melanoma, which is the main driving force for the Montreal Protocol, has been shown to be based or caused by ultraviolet radiation, a band of ultraviolet radiation that is not absorbed by ozone, which means the ozone issue may be irrelevant to melanoma. That needs to be confirmed, however. But indications are quite strong because the researchers involved in this are very reputable.

Mr. WYDEN. Thank you.

Mr. BARTON. Could I just, since you still have some time, would the gentleman yield?

Mr. WYDEN. I would be happy to yield.

Mr. BARTON. Do either of you gentlemen have data that is based on a model that has predicted and then the prediction has been within an acceptable range of what actually happened?

In other words, Dr. Watson, you indicated that there is some data as far back as 1960 and we have got satellite data in the last 15 years. Is there a model out there that has taken the past and predicted the future and we are now far enough along that we can show that the prediction actually tracked what has actually happened?

Do you understand the question?

Mr. WATSON. Yes. The answer is, no. I would agree with Fred Singer. Our understanding of the theory, it depends on what you think is reasonable. If you say can we predict it to within a factor of 2 or 50 percent, the answer is probably. Yes. We're learning all the time.

Fred Singer was completely correct when he said we did not predict the Antarctic ozone hole. Unfortunately, we hadn't even thought about the role of ice crystals. That's why it is always with research combining theoretical observations with theory and laboratory studies.

Do we have a picture if you were to try now with hindsight to predict what happened? You would probably get better than a fac-

tor of two. We understand the role of chlorine, the role of ice crystals, the role of sulfate aerosols. When we did it in advance, did we predict the future? Not very well.

Mr. BARTON. Dr. Singer, same question.

Mr. SINGER. My common-sense answer, taking Dr. Watson's testimony in which he talks about an increase in UV, sort of a worst-case assumption, of the order of 10 percent, this increase in UV would be experienced if you moved 60 miles toward the equator.

And the reason is that ultraviolet increases naturally as you move toward the equator because the sun is up higher in the sky, just because of that. In other words, if you move from here to Richmond, you would experience the same increase in ultraviolet that you would get under the worst case ozone depletion assumption that he has discussed in his presentation. That's what it's about.

Should there be concern about something like this? That's a judgment that is not a scientific judgment. I can't make that judgment. I think that's for you to make.

Mr. BARTON. The Chair would recognize Mr. Burr.

Mr. BURR. Dr. Singer, I am just sitting here trying to figure out whether that was a sale to get people to move to Washington from Richmond. I personally like to leave here on the weekends, so I am not going to be a permanent fixture.

Dr. Watson, if I could, let me follow the line the chairman was just on and really I am going to try to get back to methyl bromide for a little bit.

Tell me what would happen if we could not get a global ban, if developing countries around the world chose not to join us and other countries, would we accomplish what we tried to set out to do?

Mr. WATSON. We have accomplished a lot so far with the global ban on the CFCs and a ban on the HCFCs that are the substitutes for CFCs within at least the developed countries. However, if we want to go further, then we do need to try and have a global ban on methyl bromide. There's no question that the U.S. is only one of the contributors to methyl bromide emissions into the atmosphere.

So the point is at this moment in time, we believe, as I testified earlier, about a 6 or 7 percent ozone depletion over the United States in summer, double that in winter, and it will slowly recover by the year 2050. Very slowly that will dissipate both here and over Antarctica. In the meanwhile, many people will be exposed to cancer.

And the one point I would like to make, it is not only melanoma. There is no refuting the relationship between ultraviolet radiation and nonmelanoma skin cancer. It's about 100 times more prevalent in the USA than melanoma and about half to 1 percent of those cases is still fatal. So even if—

Mr. BURR. I understand you are impassioned about that side of it. I am here today to try to figure out about methyl bromide and whether, in fact, we have alternatives to it, whether our agricultural community can turn to other things, and in fact, does it contribute to the problem which we are trying to address. So let me try to go back to that, if I could.

Do you have any science that suggests to us that if we ban methyl bromide that the natural production of methyl bromide might not increase, that there is a balance that the atmosphere needs? Can that be ruled out?

Mr. WATSON. Yes. There are large natural sources and natural sinks. But they are independent of the human activities. And effectively, as I said, methyl bromide from fumigation sources, in essence, account for 13 percent of the cumulative ozone loss over the next 50 years. So if we could have a global ban on methyl bromide, we would reduce the cumulative ozone loss by about 13 percent; hence that number of cases of skin cancer.

Mr. BURR. I realize that science is built on a series of studies and ultimately you come to a conclusion. You said it would take several years. I think you each said six for gases to spread if they were—if they were emitted from one central location, that it would take several years for those to globally spread around.

And I guess I have a tough time, then, understanding the conclusion on the bromide because, in fact, in your own testimony it says, "Taken together, these new studies which need to be critically assessed suggest the atmospheric lifetime of methyl bromide may be shorter than suggested in the 1994 assessments, possibly as short as 0.7 years compared to the 1994 assessment value of 1.3. This would mean that less methyl bromide would reach the stratosphere than previously thought, hence decreasing the value of the ozone depletion potential, ODP." Isn't this a process that we're still learning a lot about? I mean, we have 15 years of satellite data. We have, I think, some data that you suggest that goes back to 1960. Do we have enough data to make conclusions to such strategies right now or are we better off waiting?

Mr. WATSON. It depends on how prudent you want to be to save human life from skin cancer. It's as simple as that.

Mr. BURR. You're that confident. What is it about detecting bromide and chlorine that the equal sign would be ozone depletion? Can you explain that to me?

Mr. WATSON. Yesh. It's based actually on some very simple laboratory chemistry. We have looked in the laboratory of how various gases react with each other and what we've observed is we understand how methyl bromide gets transformed into the atmosphere into what we call active forms or radical forms of bromine.

These forms of bromine, the bromine monoxide radical, the bromine atom can directly react with ozone. In fact, my Ph.D. thesis was exactly on this issue. Without ever knowing bromine in the atmosphere, we have definitively proved in the laboratory how chlorine and bromine react to ozone. It goes all the way back to very fundamental laboratory studies. We've—

Mr. BURR. Let me ask for a clarification because I'm not on your level.

Mr. BARTON. The gentleman's time is expired. We need to let him finish the answer, obviously, but don't ask another question.

Mr. BURR. Just clarification and then I'm through, Mr. Chairman.

If we eliminate the chlorine and the bromide in the atmosphere, we no longer have an ozone problem?

Mr. WATSON. We would go back to the natural background levels of ozone that we had before we put chlorine and bromine in, that will probably take about the year 2050, correct. It will naturally recover to the background level.

Mr. BURR. Even though there is a natural process that puts bromine in the atmosphere.

Mr. WATSON. Correct, there is natural chlorine and bromine and the ozone historically has come to an equilibrium. It's produced by the sun; it's destroyed by a lot of chemical processes and some of those are chlorine and some are bromine. You've got an equilibrium.

What we've done by putting in more human chlorine and bromine is disturbed that equilibrium. If you took away all the human sources of chlorine and bromine, it would go back to its natural equilibrium.

Mr. BARTON. Dr. Singer, did you want to comment on this before I recognize Ms. Furse?

Mr. SINGER. I wanted to support a point made by Mr. Burr. I disagree with Dr. Watson, incidentally, on this matter. You asked a question if you were to cutoff methyl bromide from human activities, for agricultural use, would the naturally produced methyl bromide increase?

The answer is, yes. According to a published paper by James Butler, a NOAA scientist in Boulder, Colorado, there is a kind of natural equilibrium in the atmosphere so if you remove—if you reduce human-produced methyl bromide, you would increase natural methyl bromide in the atmosphere. That's his conclusion, as I read it.

I would like to make one further statement which is that we have absolutely no published evidence that I know of of any increase of bromine in the stratosphere, any bromine compound in the stratosphere. None at all. Thank you.

Mr. BURR. Mr. Chairman, if Dr. Singer can locate that, I'd ask that that particular study be listed in the record.

Mr. BARTON. Without objection.

[The title of the study referred to is "Methyl Bromide Under Scrutiny," authored by Dr. James H. Butler, *Nature* Vol. 376, pp. 469-470, Aug. 10, 1995]

Mr. BARTON. The Chair would now recognize Ms. Furse.

Ms. FURSE. Thank you.

Dr. Watson, could you comment on the 60-mile issue? I did not quite get that.

Mr. WATSON. Well, what Dr. Singer is saying, if you reduce ozone by say 5 percent in summer, that would increase the level of ultra-violet radiation by about 10 percent. He's arguing if the level of radiation in Washington and Richmond is about 10 percent difference so in other words if everyone in Washington DC moved to Richmond, they could offset that effect of ozone depletion.

We do know and that's probably approximately correct, whether it is exactly correct, I don't know. What I do know is between about Seattle and Albuquerque, New Mexico, which is about a couple of thousand miles, there is about a factor of four difference in ultra-violet radiation between Seattle and Albuquerque, New Mexico,

and hence the incidence of skin cancer in Albuquerque is much, much higher than in Seattle.

What Dr. Singer is saying if we all move South, we could offset the effects of ozone depletion and that is indeed true. I don't see all of America moving South, personally. But the basic point is the average amount of UV you receive is what tells you what your probability of getting skin cancer is and there is no question the probability in Washington DC is less than in Richmond and less than in Florida. It's simple as that. I don't disagree with those. Whether the exact numbers are correct, I'm not sure.

Ms. FURSE. Thank you.

Dr. Singer, help me understand this. I've looked at this group of scientists from all over the world, including some whose names I recognize who are on this and then I think about the European countries which are trying to restrict methyl bromide. Why are so many European countries initiating this phaseout? Are their scientists just not very good or their politicians just not very good. What is the reason for them doing this?

Mr. SINGER. I wish I knew the answer. I mean this sincerely. It has puzzled me a great deal. I think it may have something to do with the fact that in Europe you have political parties that are environmentally oriented. You have the so-called Green Party, which plays a very important role and often makes the difference in elections.

Ms. FURSE. Thank you. I see scientists from Netherlands, from South Africa, from Kenya, from France, from Germany. I know enough about South Africa to think that's probably not political, but another question I would like to ask you is we know that there is an increasing incidence of skin cancer. Yet just a nonscientific observation would be that actually we spend more time inside now than outside.

I mean it used to be people worked outside a great deal. I, as a farmer, probably spent more time outside than I do as a Congressperson. Why are there these increases in skin cancer if they are not related to ozone depletion?

Mr. SINGER. I can answer that question.

Ms. FURSE. Then I would like to have Dr. Watson answer that.

Mr. SINGER. I think we will agree on that fact, that we must distinguish between two different kinds of skin cancer. Nonmelanoma, which seems to be caused by chronic exposure to ultraviolet B and melanoma skin cancers, which have been a mystery for some time, but now, thanks to these experiments, seem to be caused by ultraviolet A and maybe visible light as well. So the sun does play a role in all of this.

Now, all of these cancers have been increasing ever since we started taking statistics, that is for the last 60 years long before there was any discussion about ozone depletion, long before there was any use of CFCs so it clearly has to do with exposure to the sun. People do expose themselves more to the sun than they used to.

Ms. FURSE. They expose themselves more to the sun than they used to.

Mr. SINGER. That's right.

Ms. FURSE. Oh, really.

Mr. SINGER. That is the general conclusion. I'm simply giving you sort of the collected wisdom of the people who thought about this. You see this tremendous increase in melanoma, it has increased by 800 percent since 1935 in the United States. Eight hundred percent. And it is still increasing. There's nothing to do with ozone or CFCs.

Ms. FURSE. I'm worried my time is going to run out so I'm just a little anxious to get both of you as eminent scientists, I would like to hear you both.

Mr. WATSON. I don't particularly disagree with that answer. I believe the observed increase in skin cancer has largely been due to change of lifestyles. I think that change may have peaked in the 1980's and now people are—I think now we've recognized the threat of not only ozone depletion, but the threat of exposing ourselves to sun in the midday. People are being much more careful with both themselves and their children, but I believe that most of the observations that we've had of the increase in sun skin cancer probably are more attributable to life-style changes than observed ozone depletion.

Ms. FURSE. Thank you, Mr. Chairman.

Mr. BARTON. Mr. Farr.

Mr. FARR. Thank you very much, Mr. Chairman. I think you've, Dr. Watson, I would like to ask you a question because I think you've seen the frustration of the farmers in the room and I really would like to try to get at how much of the problem is the methyl bromide being used in the United States. You indicated that bromide causes about one—the loss can be attributed to about one-fourth of that from bromine.

Mr. WATSON. About one-fourth of the ozone depletion could probably be attributed to the role of bromine.

Mr. FARR. Of that, you indicated soil fumigation was about 13 percent?

Mr. WATSON. No. Of that, I would say of that—I'd say a quarter of—roughly a quarter of that 25 percent is due probably to soil fumigation.

Mr. FARR. How much to the ocean?

Mr. WATSON. The ocean is both the source and the sink so it plays a very critical role, but let's say that that would be half of it. But that's a—but that's a very natural process.

Mr. FARR. I've heard that the Arctic ice, we agree, produces some methyl bromide, but you don't know what the percentage is.

Mr. WATSON. Agreed.

Mr. FARR. How about biomass burning, what percent?

Mr. WATSON. That's probably about half of the soil fumigation, so about an eighth.

Mr. FARR. And how about the gasoline combustion?

Mr. WATSON. That's probably less, even less than the biomass burning so less than an eighth. Maybe 10 percent of it. These are very approximate numbers.

Mr. FARR. Going to soil fumigation, do you know how much was in production in 1991 because those are the levels—

Mr. WATSON. About 60,000 tons per year would be the number that I remember.

Mr. FARR. And is that worldwide?

Mr. WATSON. Yes, correct.

Mr. FARR. And the Montreal Protocol didn't freeze other countries to using the 1991 levels.

Mr. WATSON. Yes. No, the Montreal Protocol freezes all developed countries at the 1994 levels so all developed countries are limited at the 1994 levels. It's only developing countries that don't have any restrictions.

Mr. FARR. So what percentage of the soil fumigation excluding the biomass burning comes from the ozone depletion, in your opinion, is from—from use—from the U.S. farmers?

Mr. WATSON. Well, I don't have—unfortunately is what the percentage of the U.S., what the percentage of the U.S. is to the global production for soil fumigations. I suppose the number would be about half, but that's a guess on my part.

Mr. FARR. Half of what?

Mr. WATSON. About a third. Of the 60 kilotons of methyl bromide that are used probably about 20 kilotons per year are used in the USA. So the U.S. is one-third.

Mr. FARR. Of the soil fumigant?

Mr. WATSON. Correct.

Mr. FARR. That is, again, what percent, 25 percent?

Mr. WATSON. Correct.

Mr. FARR. So this is a difficulty because indeed if you are trying to battle the ozone depletion, you're taking such a small percentage of the cause. And putting 100 percent of energy or 100 percent of the restrictions into that.

Mr. WATSON. Let me put it another way, which I think simplifies it. As I said, if we had a true global ban, a true global ban on methyl bromide, we could save 13 percent of future projected ozone depletion and that was just from soil fumigation. Of that effectively one—the U.S. is about one-third of the global emissions.

Mr. FARR. And yet that is only one quarter of the loss of the ozone. There are other causes of loss of the ozone.

Mr. WATSON. Unfortunately, there is nothing we can do about the very long CFCs. There is both a U.S. domestic and an international ban on the CFCs. As soon as we've recognized how effective they were in destroying the ozone globally, there was both a ban in the United States and a ban worldwide.

The problem with many of these environmental issues is the lifetime or the residence time of these gases. Once you put them into the atmosphere, for the CFC it is decades to centuries so even though we've banned these gases they will still have an effect well into the next, middle of the next century to affect not only our children and grandchildren, but great grandchildren so we can't do anything about that. That is absolutely fixed by what we've already done. Even though we've banned CFCs, you can't do any more than that so they'll be there for a long while.

Mr. FARR. Do you agree with that?

Mr. SINGER. By the same token, the lifetime of methyl bromide is so short that we can immediately do something about it if it should be discovered and it hasn't been discovered yet that methyl bromide causes a problem with ozone. You see, if there is a problem, we don't have to put it on to our children, grandchildren or great grandchildren. One year is all it takes.

Mr. FARR. Thank you.

Mr. BARTON. Thank you. I just want the record to show that, if I followed those torturous calculations correctly, less than 4 percent of the ozone depletion in the atmosphere under the best case scenario is directly attributed to farmers using methyl bromide. I think that's the conclusion.

The Chair will recognize Mr. Bilbray for 5 minutes for questions.

Mr. BILBRAY. Thank you, Mr. Chairman. I appreciate the opportunity.

Dr. Watson, I know your concerns about methyl bromide. My question is that are you aware that we sort of caught our consumers in a Catch-22 where we are talking about ceasing the production or use of this material at the same time that the Federal Government mandates it for the importation of certain agricultural products.

Mr. WATSON. Yes, the Clean Air Act, unfortunately, when it was written, didn't observe that dilemma.

Mr. BILBRAY. So we have a Catch-22 by law. You have to use it if you import certain products. The other is that you can't use it. So de facto if we leave it the way things are right now, we will outlaw the importation of certain consumer products and food products and construction products that the American consumer desperately needs. Where do you see the answer in this basic dilemma?

Mr. WATSON. I would like USDA and FDA more to address that because I am more from a scientific perspective and a policy perspective and to see if they agree with that legal interpretation. That assumes that there will be no substitutes for methyl bromide that have an efficacy that is desirable and effectively will be registered so I think the question—I think that would be a very well-posed question to the next panel of both EPA and USDA.

Mr. BILBRAY. I was wondering if there was any civic data showing that we have another product we can use in lieu of it from the public health point of view. There are those two. I understand that in your recent scientific assessment presented to the working group meeting in Nairobi, you made it clear that accelerating the phase-out schedule of HCFCs or increasing the production cap of HCFCs in developing countries would only have a small effect on reducing risk; is that correct?

Mr. WATSON. I wasn't in Nairobi, but possibly Dr. Albrighton may have made that. I can't vouch for what he said.

Mr. BILBRAY. Do you agree with that assessment?

Mr. WATSON. Yes, that is indeed the conclusion of the international assessment.

Mr. BILBRAY. What is your major reason for believing that?

Mr. WATSON. The developing countries at the moment do not use very much HCFCs and so there was some assumptions based on some projections about what their effect would be and they are actually in Europe. We basically suggested if emissions of HCFCs were to be totally eliminated by the year 2004, that's from all countries, it would only effectively reduce the projected ozone depletion by about 5 percent over the next 50 years.

Mr. BILBRAY. The interesting thing that was brought out by Dr. Singer is the issue of the double-edged sword, of saying we need

to reduce certain substances because of their long-term impact as the cumulative problem, and thus we need to start reducing that long-term impact.

With the short life-span of this product, doesn't that give us the flip side that there is—this is a manageable issue if we respond? If we find out there is a chronic problem that needs to be responded to not just nationally, but globally, seeing that the life expectancy is so short?

Mr. WATSON. The life expectancy is somewhere around a year. It would still take 3—to be honest, about 5 or more years before its lifetime—it is the troposphere, is it the transport time to the stratosphere, so the recovery isn't actually as short as a year, but probably 10 years or around 10 years. However, the question is what evidence do you want?

At this moment in time the international community believes that both chlorine and bromine are a threat to the ozone layer. Methyl bromide is one of the sources of bromine and ozone depletion leads to a significant threat to human health, so, so far as the international community is concerned, which does not advocate for or against regulations, the case against methyl bromide has been made and I'm not sure what another 1 or 2 years would do with respect to studies.

Mr. BILBRAY. Well, there may be a great case for global starvation. What is your alternative you would suggest to the agricultural community in the absence of methyl bromide?

Mr. WATSON. I actually don't believe that the lack of methyl bromide would threaten the global food security. It's not used for most of the major grains. It is used for strawberries, tomatoes, tobacco and grapes the very, very high-priced commodities. Extremely important to society and extremely important to those farmers.

The one place you sometimes also use it, which I believe the Clean Air Act has a fundamental problem is it bans the use of methyl bromide even as a fumigant for quarantine that I believe is a major problem. But methyl bromide as soil fumigants is not used for issues such as rice and the major feedstocks of the world.

Mr. BILBRAY. But you do agree with me that for quarantine it should be continued to be used.

Mr. WATSON. Personally, I see no reason to ban it. This is a personal view, not an administration view, as long as it is not emitted into the atmosphere. I believe you need to have a system to recover and recycle it and never expose the ozone layer to its dangers.

Mr. BILBRAY. Thank you.

Mr. BARTON. Thank you. Before we release this panel, I want Dr. Singer to clarify for me something that he said. You said there are different types of ultraviolet radiation. You used A and B; is that correct?

Mr. SINGER. Yes.

Mr. BARTON. Now, the lack of ozone in the upper atmosphere allows more of one type of UV to reach the earth. Does it allow the type to reach the earth that causes the skin cancer, is that the problem?

Mr. SINGER. There are two kinds of skin cancer and two kinds of UV radiation. Let me be very precise. UV-B extends in wave-

length from 280 to 320 nanometers. A nanometer is a billionth of a meter, I guess.

Mr. BARTON. A small number.

Mr. SINGER. It's a small number. It's very small. The UV-A joins on to that and extends from 320 up to 400 nanometers and when you go to longer wavelengths from 400 to about 800 nanometers, you're in the visible part of the spectrum.

Mr. BARTON. Which is what we call sunlight.

Mr. SINGER. Yes. But the sun also emits in the UV and UV-B. Except we don't see that. Our eyes are not sensitive to that, but our skins are and that's the problem.

In the UV-B which is absorbed by ozone, UV-B, prolonged exposure to UV-B in sensitive individuals can generate nonmelanoma skin cancers which are these fairly easily removed growths on the exposed surfaces, usually the face, that can be removed and should be removed when they cause problems.

UV-A, on the other hand, causes malignant melanoma, which is a very serious and deadly form of skin cancer which cannot be taken care of in such an easy way. The estimates that EPA has made in 1987 estimating that there would be 3 million additional skin cancer deaths were done under the assumption which might have been all right at that time, but under the assumption that the UV-B absorbed by ozone would cause melanoma. We know now that this is no longer true.

It would be a good idea for the EPA, its cost-benefit analysis to revisit its previous assumptions and repeat its cost-benefit analysis.

Mr. BARTON. I'm just as confused as I was, but I have used my privileges.

Mr. BURR. Mr. Chairman, just one statement, if I could, because I think that I think Dr. Watson referenced many times that this is a human health cancer question that we are trying to address. And let me just remind those, because I am from an agricultural State that, in fact, our ability to grow food products in this country that indeed go to those countries and the world where we feed them.

Famished countries could possibly be affected so ours is genuine. We're aren't trying to skew it one way or the other. We're trying to make sure that, in fact, we are going to impact the agricultural community that we realize all the consequences that come with it and I think if there is one thing I heard from your statement today, Dr. Watson, we do have a little bit of time and I hope that we will move a little more slowly.

Mr. BARTON. I would like each of you gentlemen as our scientific experts to present to the committee for the record kind of a step by step procedure what causes A, what causes B, and how UV radiation gets to the earth.

I try to be a logical thinker and I'm just not plugged in today because of the late sessions we have had this week. I would like to go from what causes the problem to how it gets to the earth.

We appreciate your testimony and thank you both for attending.

We would now like to call forward our third and final panel, which is our administration witnesses. We have the Honorable

Mary Nichols, the Assistant Administrator for Air and Radiation at the U.S. Environmental Protection Agency.

The subcommittee will come to order so we can begin our third panel. We have three distinguished representatives of the administration before us. We have the Honorable Mary Nichols who is the Assistant Administrator for Air and Radiation at the United States Environmental Protection Agency. She feels obligated to come any time we have a hearing, I think. I think she's been at 7 of the 9 hearings that we've had.

We have Ambassador William Milam, who is a special negotiator for Bureau of Oceans and International Environmental and Scientific Affairs at the United States Department of State. And we have Mr. Larry Elworth, Special Assistant for Pesticide Policy, the Natural Resources and Environment from the U.S. Department of Agriculture.

Each of your statements will be submitted for the record. I think you're each aware that it is the tradition of this subcommittee to receive testimony under oath. Do any of you have objection to that? I think you're also very aware that you have the right to be advised by counsel during your testimony. Do any of you so wish to take advantage of that right?

Then will each of you please stand and raise your right hand?
[Witnesses sworn.]

Mr. BARTON. Your statements will be submitted for the record. We ask you to summarize them in 5 minutes. We will start with Ambassador Milam and then Ms. Nichols and then Mr. Elworth. If that's the correct protocol. The State Department is the oldest department.

Mr. MILAM. I may be the oldest representative.

Ms. NICHOLS. I'll concede immediately.

Mr. BARTON. I'm not a protocol person, but I will start with Mr. Milam if there's no objection. Ambassador Milam.

TESTIMONY OF AMBASSADOR WILLIAM MILAM, SPECIAL NEGOTIATOR, BUREAU FOR OCEANS AND INTERNATIONAL, ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE; HON. MARY D. NICHOLS, ASSISTANT ADMINISTRATOR FOR AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY; AND LAWRENCE ELWORTH, SPECIAL ASSISTANT PESTICIDE POLICY, NATURAL RESOURCES AND ENVIRONMENT, DEPARTMENT OF AGRICULTURE

Mr. MILAM. Thank you, Mr. Chairman. I am glad to start out. I will submit my very brief formal testimony for the record and give you about 60 seconds of summary, if that's OK.

Mr. BARTON. That would be amazing.

Mr. MILAM. Well, I hope to amaze.

I want to say three things. I'm the negotiator for the Montreal Protocol. I have been for about a year. It is a very successful treaty, very successful protocol and I think that's really the first point I need to make not on in its accomplishments and you've heard much of that from previous speakers, but also from my own experience it is very successful in the way it works. It's one of the most workmanlike of negotiations I've ever been involved in, absent a lot of political rhetoric and a very workmanlike atmosphere.

Second point, Mr. Chairman, is one that I hesitate to make, but I can't—but I think I should. I know this is not an Appropriations Committee or Subcommittee, but I have to point out that the Protocol has worked very well because of the multilateral fund which was established 5 years ago and our latest appropriations numbers, which, of course, are not law yet, would cut our contributions to the fund very significantly and make it more difficult for us to do what we want to do within the Protocol and make it more difficult, I think, for us to achieve our objectives.

Third point really is that we're going into—we've had one negotiation in Nairobi. We have two more left. Our objectives there are to carry out, really we have few major issues.

One is HCFCs, which I won't bother you with because it's a complicated issue, but we have an objective there which is to maintain our—the current phaseout and you're objective with methyl bromide is to see that all countries phaseout by 2001 with certain exemptions for preshipment quarantine and essential uses and I think, Mr. Chairman, I would leave my summary of my statement at that. Thank you.

[The prepared statement of Ambassador William B. Milam follows:]

PREPARED STATEMENT OF WILLIAM B. MILAM, SPECIAL NEGOTIATOR, DEPARTMENT OF STATE

Mr. Chairman, I would like to take this opportunity to thank you and the other members of the subcommittee for the opportunity to speak to you on stratospheric ozone protection, a matter of increasing importance to the international environmental policy of the United States.

In recent years, man-made production and consumption of materials that deplete the ozone layer have posed the risk of increasing the numbers of cases of skin cancer, suppressing the human immune system, and damaging plant and aquatic organisms. The global effort to respond to this threat, which knows no national boundaries, centers around the Vienna Convention for the Protection of the Ozone Layer and its 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. 150 nations have acceded to this successful international accord. Under this Protocol, the parties have agreed to phase out, with an extended time frame for developing countries, these ozone depleting substances. The Protocol has been a success because it has, heretofore, not been politicized or fallen victim to North-South frictions. The agreement is a paradigm of international cooperation at resolving a common problem. We want to ensure it remains highly successful.

The world's leading atmospheric scientists in their report entitled "Scientific Assessment of Ozone Depletion: 1994" have observed substantial decreases of ozone during the course of all seasons at midlatitudes (i.e., 30°-60°) in both the southern and northern hemispheres. For example, in the midlatitudes of the northern hemisphere, the decline averaged some 6% between 1979 and 1994. Similarly, the scientists reported that ultraviolet levels were elevated in the northern hemisphere at these latitudes in both 1992 and 1993. Moreover, the National Oceanic and Atmospheric Administration reported recently that ozone levels for the mid and high latitudes in the northern hemisphere were down 10-20% last winter over what was noted during the same months in 1979 and in the early 1980s.

According to the Protocol, the world's scientific community is tasked every four years to gather the most current data on the effectiveness of the control measures the parties have adopted. This fall, the Conference of the Parties will meet in Vienna to review the phaseout schedule for hydrochlorofluorocarbons (HCFCs), additional measures with respect to methyl bromide and developing country controls of chlorofluorocarbons (CFCs).

As to HCFCs, our position at Vienna and at the preparatory meeting of the Protocol's Open-Ended Working Group in Geneva later this month will be to maintain the current cap and phased reduction schedule for developed countries through 2030 with an exemption for essential uses. This serves to protect the interests of American industry which has invested large sums in HCFC chemicals and processes. Currently the Protocol imposes no controls on developing countries. While the latter

nations use relatively small amounts of HCFCs, we believe that a freeze on developing country consumption would serve to ensure protection of the ozone layer. While a phaseout would be better, existing demands on and the availability of funding for the Protocol's Multilateral Fund, an institution about which I will say a bit more shortly, does not, at this time, make this a realistic option.

Concerning developing country production of CFCs, there will be a number of options presented to the parties in Vienna. Currently, the Protocol calls for a 2010 phaseout. We will push for a scenario which improves upon this without imposing unrealistic burdens on the Fund.

Lastly, with regard to methyl bromide, we will continue to advocate a 2001 phaseout for both the developing and developed world and a provision for exemptions for essential uses, quarantine, and preshipment.

In the 1994 Scientific Assessment cited above, the scientists underscored the efficacy of the Protocol in stemming the growth of the major ozone depleting substances (i.e., CFCs and halons). Furthermore, the experts have also identified an increase in the atmosphere of CFC substitutes such as HCFCs. In fact, the scientists believe that the integrity of the ozone layer should be restored by the middle of the next century if the parties adhere to the Protocol and its attendant amendments and adjustments.

The Protocol has gained virtual universal acceptance as a result of the creation in London in 1990 of the Montreal Protocol Multilateral Fund. The Fund was established to help countries whose per capita annual consumption of CFCs was relatively low to meet their phase out commitments under the Protocol. The developed world agreed to support the Fund because 1) assistance was limited to the incremental or "extra" phaseout costs; 2) aid was to be given only to developing countries whose historical consumption of ozone depleters was very low; and 3) the amount of the Fund was considered a small price to pay to protect the substantial domestic investments that developed countries had to make to phase out ozone depleting substances. In effect, the developing country recipients of the Fund, most of them very poor, agreed that a partnership was necessary to solve a problem which was not primarily of their making. The nearly \$315 million already disbursed by the Fund for more than 800 projects in over 80 developing countries is expected in due course to result in a one-quarter to one-third reduction of developing countries, current use of ozone depleting substances. Many developing countries are even phasing out their reliance on such substances ahead of the Protocol schedule. Thus, a relatively small expenditure of funds has the potential of generating a large dividend for the world community.

However, the current funding situation we now face poses major difficulties. The U.S. was the major force behind the \$510 million replenishment (the U.S. share is about \$114 million) for 1994-1996. But, we are now in the position of being unable to pay our contributions to the Fund. We may encounter further difficulties in the years to come, as the appropriation account from which the State Department's Montreal Protocol contributions originate faces steep reductions in FY 1996 and subsequent years. Congress has also reduced EPA funding for the Protocol's Fund.

Our continued ability to contribute to the Multilateral Fund will have a direct effect on this year's discussions on methyl bromide. As I stated earlier, our position in these talks has been that there should be a universal phaseout in developed and developing countries in the year 2001. Our objective is to maximize ozone protection and ensure that U.S. growers are placed at no competitive disadvantage compared to other countries.

Given the available scientific evidence that methyl bromide is an ozone depletor, phasing it out quickly is the single best thing we could do for the ozone layer. This would assure a level playing field for U.S. growers. In support of our basic position for a universal phaseout in developed and developing countries, we endorse the notion of opening the Multilateral Fund to include methyl bromide demonstration projects. These projects would be funded from within available contributions to the Fund.

Thank you, Mr. Chairman.

Mr. BARTON. Thank you. Since you do have time, do you care to—is that your chart or is—

Mr. MILAM. It's not mine.

Mr. BARTON. I thought it was yours. I was going to let you explain, but we'll let whoever it is explain it. We would now recognize Ms. Nichols from the EPA.

TESTIMONY OF HON. MARY D. NICHOLS

Ms. NICHOLS. Thank you, Mr. Chairman. And since you acknowledged my frequent appearances before this committee, I would like to just mention to you that the last time I appeared before you, you gave us an extension of time to respond to some questions which you had tendered to us in writing and I wanted to let you know that the answers are being delivered to you today.

Mr. BARTON. Good. I will read them today.

Ms. NICHOLS. I am the person who brought that chart along and before I launch into a very brief summary of my testimony, I think this may be helpful in terms of illustrating the background for the cost-benefit numbers that were cited by the earlier panel.

The three different charts on this one big poster board show you the effects really of the Montreal Protocol. The one on the left at the bottom there shows you the actual ozone layer or the change in the ozone. What would have happened without the Protocol phaseout is the green line headed straight down. The purple line that goes off is with the Protocol.

The upper right shows you the amount of chlorine and bromine in the atmosphere. It's basically the opposite going up without the Protocol and leveling off and coming down with the Protocol and then the bottom line indicates what the effect of compliance with the Protocol is on fatalities from skin cancer. These are EPA estimate numbers, but they are based on international scientific data that has been published and peer-reviewed and those are just there for illustrative purposes.

I agree with Ambassador Milam that Title VI recommends one of the major success stories of the 1990 Clean Air Act amendments. We would note that it had strong bipartisan support from the beginning. It was based on strong science at the time and it's a remarkable global response to a threat that was perceived as global. One hundred and fifty nations are parties to the Montreal Protocol.

It has been successful in phasing out halons, which were widely used as fire extinguishing agents and CFCs met that. Methyl chloroform and carbon tetrachloride are all scheduled for phaseout during the course of the year by all involved parties.

At the same time we can't be complacent. All nations need to comply with the Montreal Protocol. We believe based on the science that we reviewed that methyl bromide and HCFCs also will need to be phased out not just in the U.S., but again globally and we would point out that even with all these heroic efforts, ozone levels are not going to return to their natural undepleted levels before the middle of the next century.

Now, much of what you have heard today, much of the concern revolves around the important role of methyl bromide to the agricultural community and we are aware of the important uses of methyl bromide and are committed to working with farmers to both facilitate the search for an alternative which we ourselves have helped to fund in a small way. And also to support the needed scheduled phaseout with time to find alternatives in the cases of other chemicals that we have successfully succeeded in phasing out. This process has worked.

I would only point out in this stage of the phaseout of other chemicals such as CFCs, very sharp concerns and problems were

raised. For example, in the case of electronics, cleaning in our high-tech electronics industry, we were told at about this stage in the process that the industry did not have viable alternatives.

Those that appeared possible weren't working very well, were too defensive. There was a serious concern about industries having to move to other countries in order to use those chemicals and as it turned out, of course, the electronics industry was one of the first to phaseout CFC 113.

Now, obviously there is no guarantee that the process will work as well for agriculture as it did for electronics. We realize that, but we do believe that we have enough of a track record to say that there is no reason to radically change course now.

However, we also recognize that there is a need for a safety valve, that there must be the assurance that at the end of the day, if the alternatives are available and that there will be the possibility of an essential use exemption.

However, we think that this is premature to grant such blanket exemptions at this time given where we are in the process of developing the alternative and given the compelling need for global action on methyl bromide that you heard from Dr. Watson.

For the U.S. to unilaterally signal that we were pulling back I think would make it very difficult for us to pursue the strategy that Ambassador Milam outlined in terms of getting the rest of the world to go along with the ban. So I would like to thank you for your interest and your attention and look forward to working with you in our efforts to protect the ozone layer.

[The prepared statement of Hon. Mary D. Nichols follows:]

PREPARED STATEMENT OF MARY D. NICHOLS, ASSISTANT ADMINISTRATOR FOR AIR AND RADIATION, EPA

Mr. Chairman, Members of the Subcommittee, thank you for the opportunity to address you once again on an issue of extreme importance to our health and environment, and to sustaining the health of our future generations. This truly represents one of the major success stories of the Clean Air Act and its implementation. The cornerstone of this effort was sound science driving the policy response that has resulted in an international treaty now agreed to by 150 nations.

I am also pleased to say that this issue has had broad bipartisan support from the beginning. The original Montreal Protocol was negotiated and signed under President Reagan. President Bush was responsible for accelerating the phaseout of ozone-depleting substances, first in 1990 and again in 1992, and for expanding the list of regulated substances to include methyl chloroform, carbon tetrachloride and HCFCs. In addition, the original proposal to list and phase out methyl bromide occurred at the end of the Bush Administration.

Politics aside, the place to begin in discussing Title VI must be the state of science. The key scientific issues can be captured in four simple questions: Is the ozone layer depleting? Are man-made chlorinated and brominated compounds responsible for the depletion? Has harmful UV-B radiation increased? Are human health and the environment at risk from increased UV-B radiation?

The answer to the first question, despite what you may read in some political commentaries, is unequivocally yes. Based on both ground-based and satellite measurements over a period of several decades, we can say with great confidence that ozone depletion has occurred. Based on the latest review of data, depletion on the order of 4-5% per decade has been measured across northern and southern mid-latitudes.

It is important to realize that this and other information doesn't simply represent EPA's view of the science, but is drawn from the most recent Scientific Assessment (Scientific Assessment of Ozone: 1994; WMO Report 37), which is prepared and fully peer-reviewed by almost 300 of the world's leading atmospheric and health scientists. It represents the definitive assessment on the state of the science and provides sound basis for EPA and international action.

The second question is whether man-made emissions are the culprit responsible for depleting ozone. Based on extensive field and laboratory studies, the science community has concluded that man-made chlorine and bromine compounds are responsible for the Antarctic ozone hole and largely responsible for mid-latitude depletion.

Do we know if UV-B radiation has increased? While we have no credible long-term record, we have increasing information from instruments in such widely disparate places as Antarctica, South America, Canada and Alaska that when decreases in ozone have occurred, increases in UV-B radiation were also observed.

Finally, and most importantly, why should we care about ozone depletion? Extensive studies have shown that increases in UV-B radiation will lead to long-term increases in incidence of skin cancers and cataracts, damage to crops and aquatic organisms, and suppression of the human immune system. Furthermore, increased UV-B will exacerbate the problem of low-level or smog formation, a major air pollution concern. The bottom line is that we care a great deal about maintaining the integrity of the earth's ozone layer.

The United States and the world have made significant progress to date in addressing this problem by eliminating many man-made, ozone-depleting chemicals. As of today, production of halons was eliminated 18 months ago and at the end of this year, production of CFCs, methyl chloroform, and carbon tet ends. The rate of increase of atmospheric concentrations of such chemicals as chlorofluorocarbons (CFCs), halons, carbon tetrachloride and methyl chloroform, has slowed, and in some cases, declined. Scientists have proclaimed the Montreal Protocol a success. Nevertheless, the Antarctic ozone hole will persist well into the next century even with *continued compliance* with the Montreal Protocol. Thus, despite our success, there cannot be any backsliding. Full and complete restoration of the ozone layer will not occur unless there is a complete international phaseout of these chemicals, including methyl bromide.

We have an incredible success story to tell with the work completed on Title VI of the Clean Air Act. We began the process of implementing Title VI by consulting stakeholders. Regulations have been drafted with the cooperative involvement of industry, scientists, consumers, and environmental interests. Throughout, sound science has been the basis for technical decisions. Cost-benefit analyses were completed and peer-reviewed. Benefits far outweighed the costs, further supporting the need to put regulations into place swiftly.

To date, the Agency has promulgated regulations to phase out the production of ozone-depleting chemicals, to require recycling of refrigerants as well as the labeling of products made with and containing ozone depleters, and implemented a program to review the development of safe alternatives. HCFCs, less potent ozone depleters than CFCs, are slated for a phaseout by the year 2030.

EPA is successfully implementing its regulations, with a high level of cooperation from the industry and consumers. Over 600,000 technicians have become certified to work on stationary refrigeration and air-conditioning equipment and properly recover refrigerant from that equipment. EPA has approved 95 organizations to test and certify refrigeration technicians and has certified 70 refrigerant reclaimers, further encouraging the reuse of used refrigerants at a high purity level. EPA continues to work with professional and trade organizations to update industry standards.

Compliance levels are high, notably in the refrigeration sectors. Nevertheless, rigorous inspections have yielded results in enforcement actions against potential violators. On the civil side, EPA has filed 106 enforcement actions, with a total of \$1.4 million proposed in penalties. Of those 106 cases, 28 have been settled, and a total of \$94,000 collected.

EPA has put in place a marketable permit program that serves as the cornerstone to its regulatory program. By allocating permits or allowances to chemical producers, EPA can limit the volume of production of ozone-depleting chemicals. This restriction in supply rations these chemicals in the marketplace without costly controls. To date, about 585 million kilograms of CFCs and related substances have been traded through EPA's allowance system. This system has successfully allowed producers and importers latitude to vary from their baseline allotments, where a command and control system would have allowed no flexibility. Indeed, this approach, coupled with the excise tax on ozone-depleting chemicals, has been successful in minimizing the cost of the phaseout, encouraging innovative, creative, cost-effective industry responses.

Since the genesis of this system, we have successfully phased out halons without the catastrophic repercussions that were predicted. Recycled halon is being used where necessary, and elsewhere, retrofitted fire protection systems accommodate alternatives. At the end of this year, all remaining class I substances other than methyl bromide are being phased out.

Market response has been astounding. We are seeing hundreds of new, never-before anticipated substitutes coming onto the market. New business opportunities are being realized. Several industries have switched to these substitutes before the required phaseout date. The electronics industry also deserves special mention for its success in achieving an early phaseout. Not only were U.S. telecommunications firms in the vanguard of companies that stopped using CFCs prior to the phaseout, but they also managed to turn the phaseout into an opportunity for improved industrial excellence—both in terms of enhanced competitiveness, as well as sustained commitment to the environment. For example, companies introduced “no-clean” technologies that dramatically reduce dependence on hazardous cleaning chemicals and at the same time improve assembly rates and reduce associated production costs. Satisfaction with the new processes has been so high that firms have formed a unique consortium—the International Cooperative for Ozone Layer Protection—to share these exciting innovations with other companies that could also benefit. This is very encouraging news.

The benefits of the phaseout exceed its costs by a factor of more than 1000 to 1. Based on several extensive regulatory impact analyses, EPA estimates that the cost of the current 1996 phaseout requirements will be approximately \$10 billion for the period between 1989 and 2000 and approximately \$42 billion over the period 1989-2075. The public health benefits from reduced cases of skin cancer, cataracts, and other health effects are estimated to be between \$8 and \$32 trillion over the same period (the range depends on the assumed value of a life).

Recently, however, there have been some highly inflated reports concerning the costs of the phaseout. For example, the Competitiveness Enterprise Institute (CEI), erroneously assuming that all existing air-conditioning and refrigeration equipment would have to be discarded and replaced immediately. Of course, nothing in EPA's regulations requires this. Existing equipment can remain in use indefinitely, and substantial amounts of recycled CFCs will be available to repair it. Industry has also been extremely successful in developing highly energy-efficient new equipment that works without CFCs. Overall costs will be relatively low because these energy efficiency gains drastically reduce lifetime operating expenses. In fact, in some sectors, such as household refrigeration and building chillers, it will often pay for homeowners or building owners to replace current equipment well before it has broken down. Although the transition away from CFCs will not be free, EPA estimates cost of the phaseout to be \$4 billion to this sector over a 12-year period, one-tenth to one-twentieth the \$45 to \$100 billion figure from CEI.

To date, the Agency has focused much of its attention on motor vehicle air-conditioning, which once faced significant challenges in phasing out CFCs. However, we are now very optimistic that the move to alternatives for cars will be relatively smooth. First, many 1993 models and all new 1994 and 1995 model cars use HFC-134a, a non-ozone-depleting refrigerant. Second, mandatory recycling and recovery during service and disposal of older vehicles will ensure that we make the best use of the CFCs now in existing equipment. Third, the marketplace has responded to the production phaseout by building significant reserves of CFC-12 for sale and use after the production ban. Again, it is important to recall that while production ceases at the end of this year, there is no restriction on the use of existing stocks of CFCs. Fourth, the cost of retrofits, sometimes alleged to be on the order of \$800-\$1,500 per car, has come down considerably. The most recent Technology Assessment Report concluded that for many cars when repairing an air-conditioning system, the added cost of shifting to HFC-134a should be under \$100. Finally, the private sector continues to develop and test innovative refrigerants that could further reduce costs to consumers. Taken together, we believe that even this potentially difficult transition can and will be accomplished with a minimum of costs and disruption to the public.

I'd like to turn now to the issue of methyl bromide. Unlike the other ozone-depleting substances, whose production will stop by the end of this year, methyl bromide is slated for phaseout by 2001. Because of the economic issues involved, there is great interest in the phaseout of methyl bromide. I want to clarify what has been decided by Parties to the Montreal Protocol, and subsequently by EPA. First, let me stress that anthropogenic methyl bromide has indeed been positively linked to the depletion of stratospheric ozone, and that substantial progress is being made on alternatives. Let's look more closely at this issue.

In 1992, a UNEP peer-reviewed international scientific assessment was completed by over 200 scientists, concluding that the best estimate of the ozone-depleting potential (ODP) for methyl bromide was 0.7. At the 1992 meeting of the Parties to the Protocol, methyl bromide was listed as a class I substance and production was frozen for 1995 at 1991 levels, applicable to developed countries, with exemptions for the use of methyl bromide in quarantine and preshipment. In compliance with

the Protocol and the Clean Air Act, EPA listed methyl bromide as a class I substance in December 1993, with a phaseout date of January 1, 2001, the maximum time allowed by the statute. In this rulemaking, EPA froze production and importation in 1994 at 1991 levels, and allowed 100% of this level until the phaseout date in 2001.

The 1994 UNEP Scientific Assessment of Ozone Depletion, peer-reviewed by over 250 scientists, found that the ozone-depleting potential for methyl bromide is 0.6. The range of uncertainty would bring it to no lower than 0.3 and no higher than 0.9. Even the lowest end of this range exceeds the 0.2 threshold that makes a chemical a class I ozone depleting substance that must be phased out under the Clean Air Act. The 1994 Science Assessment states that "Methyl bromide continues to be viewed as a significant ozone-depleting compound." Additional research is ongoing to address outstanding uncertainties, and to define the precise ODP, which may turn out to be slightly higher or lower than 0.6. The Assessment also stated that the elimination of anthropogenic methyl bromide emissions is the single most effective policy to further reduce ozone destruction over the next several years.

Farm users of methyl bromide are understandably concerned that they do not currently have satisfactory substitutes for all uses of this chemical. I understand and am sympathetic to their concern. The critical issue, though, is not whether adequate alternatives for all methyl bromide uses are available *now*, but whether they *will* be available by the time the phaseout deadline arrives. There will not be a single chemical that replaces all of the many uses of methyl bromide. But numerous chemical and non-chemical methods exist today that effectively control many of the pests on which methyl bromide is used. In addition, research on additional alternatives is under way and will likely result in a wide range of options. Viable alternative materials need not be identical to methyl bromide, but must effectively and economically manage pests now being controlled by methyl bromide. Alternatives to methyl bromide are often pest-specific, and can reduce pest levels when used as part of an overall integrated pest management program.

While not all of the alternatives I touch upon are technically or economically ready to be used by farmers, all have shown a good potential to control pests currently controlled by methyl bromide, and are expected to be in place and available around the year 2001. For soil use, chemical alternatives include 1,3-dichloropropene, dazomet, chloropicrin, and metam sodium, as well as selective contact insecticides and herbicides. Non-chemical soil alternatives include crop rotation, organic amendments, steam, solar heating, biological control agents, cultural practices, and plant breeding. Alternative chemicals for use in commodity applications include phosphine and carbonyl sulfide. Non-chemical commodity alternatives include irradiation, controlled atmospheres using nitrogen and carbon dioxide, and heat/cold. Alternatives for structural treatments include the chemicals sulfuryl fluoride and phosphine, as well as contact insecticides and rodenticides, and the non-chemical alternatives such as controlled atmospheres using nitrogen and carbon dioxide, and heat/cold.

When considering concerns about the availability of alternatives to methyl bromide, it is important to reflect on our experience in phasing out the other ozone-depleting chemicals. Our success with the phaseouts of CFCs, halons, carbon tetrachloride, and methyl chloroform—which have been or are being eliminated in hundreds of applications by dozens of industries—shows that the phaseout process works. By establishing a firm date for an ultimate ban, but allowing a period of time before it takes effect, the phaseout process creates the necessary market incentives for producers and users to develop effective alternatives. With each of these other chemicals there were dire warnings at similar stages in their phaseout schedules that suitable alternatives would not be found in time. For example, several years ago, the fire protection industry expressed grave doubts that substitutes would be available in time for the halon phaseout and painted catastrophic pictures of what could happen without halon to extinguish fires. As I mentioned earlier in my testimony, the 1993 phaseout of halons has been extremely smooth, with viable substitutes becoming available before the phaseout. There have been none of the predicted dire consequences. The same is proving true for CFCs and the other chemicals. There is every reason for optimism that the phaseout process will work for methyl bromide, given the intensive research going into substitutes.

The recent Methyl Bromide Technical Options Committee Report, prepared under the Montreal Protocol, stated that alternatives were either technically feasible or in the advanced stages of development for over 90% of methyl bromide uses. This statement does not mean that alternatives are currently commercially available each methyl bromide application. Many alternatives need further refinement and testing in the field for specific applications. But the Committee's statement does re-

flect the wide range of possible alternatives exist that and can be further evaluated and developed in order to be available prior to 2001.

EPA's Office of Air and Radiation and Office of Pesticide Programs are working in a coordinated effort with USDA to support the efforts by growers to fully evaluate the viability of alternatives. Further, the Office of Pesticide Programs has committed to giving priority review to alternatives to methyl bromide that come forward for registration. As I stated above, the existence of the 2001 phaseout deadline provides a clear incentive for the development of alternatives and that this process, if history is any guide, should result in driving the rapid introduction of alternatives.

We fully recognize that there is no guarantee that acceptable alternatives will be available for all uses of methyl bromide prior to 2001. We believe that having a safety valve—allowing continued production for specified essential uses where no alternatives exist—is an important part of this process. In our 1993 Federal Register notice establishing the phaseout of methyl bromide, EPA made it very clear that if alternatives are not available for specific uses when the phaseout deadline approaches, we will seek an appropriate remedy.

I intend to work towards a solution to these concerns as we have successfully resolved other Clean Air Act implementation issues. To this end, we are ready to start work now with all stakeholders on approaches to a safety valve that would permit applications for essential use exemptions if they are needed as the phaseout deadline approaches. This will meet the farm community's need to know how the safety valve process will work, while maintaining incentives for continued efforts to develop alternatives.

Before leaving methyl bromide, it is important to once again remember why we need to phase out this compound. The most recent Scientific Assessment document states that the phase-out of methyl bromide is the most significant policy action that can be taken to further reduce the near-term risks of ozone depletion, reducing the total amount of ozone-depleting chemicals in the atmosphere by 13 percent from current levels.

There are other challenges facing EPA during this transition to non-ozone-depleting chemicals. We have witnessed a recent surge in illegal imports of CFC-12. EPA is working with Customs, IRS, and the State Department to stem the flow of these illegal shipments. Thus far, seven arrests have been made and four have been criminally convicted. One of the convicted was sentenced last week to two years in prison. One of those arrested is on trial today, as we speak. As a result, U.S. Customs officials are already noticing a significant decline in these imports.

We are well aware that issuing the Title VI regulations and working with industry is only one piece of the puzzle. The most challenging outreach task is to explain the CFC phaseout and what it means directly to the people who own air-conditioning and refrigeration equipment. These people must make decisions about whether to convert that equipment to non-CFC refrigerants and if so, when to do that. We have had an active outreach effort since 1992 to provide such information to the public. We have had a multi-year campaign to provide guidance on the CFC phaseout and air-conditioning and refrigeration to building owners, facility managers, and small businesses. Our Stratospheric Protection Hotline responds to 6,000 phone calls each month.

For automobile owners, EPA has issued a joint consumer guide with the motor vehicle manufacturing and service industry. This year, EPA significantly stepped up its efforts to reach the public directly and through auto technicians. Working closely with the motor vehicle service organizations, we have produced new brochures, done a substantial direct mail effort, attended trade shows, and written articles for trade press and consumer organizations.

Internationally, the United States must continue to support developing countries in their transition to alternatives. Only a complete international phaseout of these chemicals will return ozone concentrations to normal levels. Continued participation in the Multilateral Fund that supports these efforts is critical. If developing countries do not meet reduction schedules, use of ozone-depleting substances could quickly grow to levels that would completely nullify the billions of dollars invested by the world's developed countries in phasing out these substances.

I have touched on several important aspects of EPA's stratospheric protection program. One major point is worth reiteration. We must stay the course if we are to be successful in restoring the ozone layer. We must continue our leadership role in the Multilateral Fund, meet our phaseout commitments as a Party to the Montreal Protocol, and work to find alternatives to methyl bromide. Thank you, Mr. Chairman, Members of the Subcommittee for your attention. I would be happy to answer any questions you may have.

Mr. BARTON. Thank you. I now recognize Mr. Elworth from Department of Agriculture.

TESTIMONY OF LAWRENCE ELWORTH

Mr. ELWORTH. Thank you, Mr. Chairman. I want to thank you and the subcommittee for the opportunity to discuss these complicated issues surrounding methyl bromide regulation. The public policy debate over methyl bromide regulation takes place at the intersection of international environmental protection and domestic regulation, and significant impacts on U.S. agriculture. At issue is the Clean Air Act requirement to phaseout all use and production of methyl bromide in the U.S. by 2001. This unilateral regimen for the U.S. is far more restrictive than the provisions for methyl bromide under the Montreal Protocol that govern the actions of the rest of the world.

As a result of this differential, between domestic and international requirements there is a profound concern within agriculture that, without adequate alternatives U.S. farmers will be put at a significant competitive disadvantage in international agriculture and trade when the phaseout takes place.

Methyl bromide provides highly effective control for a broad spectrum of economically important pests on a wide range of food and nonfood commodities. The largest use for methyl bromide is, as many people have noted, as a soil fumigant for intensive production of high value crops. The 1993/94 production values of just the top six crops using methyl bromide for preplant treatment was \$2.4 billion dollars.

Methyl bromide is also important for quarantine and preshipment treatments. U.S. regulations and commercial agreements require that a wide array of imported food and nonfood commodities be fumigated with methyl bromide. In addition, a number of commodities exported by the U.S. must be fumigated with methyl bromide in order to comply with the quarantine requirements of recipient countries. The market values for the five major commodities exported to countries that require methyl bromide treatment total \$232.8 million for the fiscal years 1993 and 1994.

It's really the current extent and importance of methyl bromide use and the potential impacts of the 2001 phaseout for American agriculture that necessitate a major effort to ensure that farmers can continue to raise and market their crops effectively. USDA has for many years conducted a significant amount of research that is relevant to the problem of replacing methyl bromide.

However, since EPA announced the phaseout for methyl bromide, ARS has increased its efforts to find alternatives. Spending for methyl bromide alternatives increased from \$7.4 million in fiscal year 1993 to the current \$13.1 million for fiscal year 1994 and 1995. This spending supports 42 scientist years involving 46 projects across the country.

For 1996 the President's budget requested \$13 million for USDA to continue this aggressive research program. In addition, this effort is augmented by research funded by growers and the funding that Mary mentioned from EPA and finally USDA is working directly with EPA's office of Pesticide Programs to ensure that any

alternatives that need to be registered by EPA will be able to act expeditiously to provide that registration.

In short, Mr. Chairman, we are taking the need to find important alternatives for farmers very seriously. Despite our confidence in the efforts of our researchers, however, USDA also recognizes that there are a number of real world factors that affect our ability to find alternatives. We recognize that a wide variety of crop applications spread over a diverse set of geographic conditions across the whole country will have to be found and that no single practice will substitute for all of the current methyl bromide uses.

The bottom line is that we must be realistic in recognizing that the final test of an alternative is its adoption for field application. Even with the sincere commitment of USDA, EPA and growers to develop alternatives, we may still find situations where effective alternatives will not be available for important uses by the time the phaseout takes effect.

The consequences of that eventuality would pose a significant competitive disadvantage for American agricultural production and trade especially if we do not have an effective safety valve for essential uses both domestically and internationally.

Let me be clear, Mr. Chairman, USDA fully supports efforts to prevent adverse environmental and human health impacts from the degradation of the stratospheric ozone layer. We believe that international environmental progress is possible through unified action by all countries by building on the successes of the Montreal Protocol.

Our hope is that domestic policy issues can be worked out so that we are not hampered on the one hand in achieving international consensus on environmental protection and on the other hand by possibly putting our agriculture and trade at a competitive disadvantage.

Mr. Chairman, this administration has consistently maintained that a vital economy and a healthy environment can and should go hand in hand. The debate over methyl bromide regulation offers an opportunity for all of us to work together in achieving those goals.

We appreciate your interest, Mr. Chairman, in initiating debate on this issue and we look forward to working with you in Congress, with EPA, and other stakeholders to craft a reasonable solution to this problem. That concludes my statement. I would be glad to answer any questions.

[The prepared statement of Lawrence Elworth follows:]

PREPARED STATEMENT OF LAWRENCE ELWORTH, SPECIAL ASSISTANT FOR PESTICIDE POLICY, UNITED STATES DEPARTMENT OF AGRICULTURE

Mr. Chairman, thank you for the opportunity to discuss with you and other members of the Subcommittee the regulation of methyl bromide under the Clean Air Act. Under the leadership of Secretary Glickman and Deputy Secretary Rominger, the Department of Agriculture has taken an active role in both international and domestic deliberations on stratospheric ozone depletion and the future of methyl bromide use. Although long-standing commitments prevent Deputy Secretary Rominger from appearing before you today, I want to assure you that USDA appreciates the interest of this Subcommittee in the complicated issues surrounding methyl bromide regulation.

The public policy debate over methyl bromide regulation takes place at the intersection of international environmental protection, domestic regulation, and significant impacts on United States agriculture. At issue is the Clean Air Act requirement to phase-out all use and production of methyl bromide in the United States

2001. This unilateral regimen for the U.S. is far more restrictive than the provisions for methyl bromide under the Montreal Protocol that govern the actions of the rest of the world, in particular its provisions for essential use and exemptions. As a result of this differential between domestic and international requirements there is a profound concern within agriculture that, without adequate alternatives, U. S. Farmers will be put at a significant competitive disadvantage in international agriculture and trade when the phaseout takes effect.

It is the significant impacts on American agricultural production and trade from Clean Air Act regulation of methyl bromide that have made this issue a high priority within USDA. Methyl bromide provides highly effective control for a broad spectrum of economically important pests on a wide range of food and non-food commodities. It provides a rapid and complete control of pests, mostly within 24 hours of exposure, for fumigation of large and small quantities of material and, when applied properly, does not leave residues of a toxicological significance. The compound is widely used in agriculture as a soil fumigant, for postharvest applications (including quarantine and stored agricultural commodities and durable products such as cotton, timber and artifacts) and structural fumigation. It is active against a diverse variety of organisms at low concentration, including rodents, insects, mites, nematodes, fungi, weeds, bacteria and viruses. Its broad spectrum activity and ease of application have led to its important role in pre-plant use and as the treatment of choice in a number of situations.

The largest use for methyl bromide is as a soil fumigant and for intensive production of high value crops such as strawberries, tomatoes, cucumbers, peppers, melons, and eggplant. The 1993/94 production values for these six commodities using methyl bromide for preplant treatment were \$2.4 billion. In addition to these six commodities, a 1993 USDA assessment report showed an additional 15 commodities for which methyl bromide was also important in their production.

Methyl bromide is particularly important for quarantine treatments because of its effectiveness against a large variety of indigenous and non-indigenous pests and because it can be easily and economically applied to both small and large shipments. U.S. regulations require that a wide array of imported food and non-food commodities be fumigated with methyl bromide as a condition of entry. In addition, a number of commodities exported by the United States must be fumigated with methyl bromide in order to comply with the quarantine requirements of recipient countries. A critical quarantine use of methyl bromide to U.S. agriculture is its role as the only practical emergency treatment to move commodities out of areas quarantined for outbreaks of exotic pest insects such as the Mediterranean fruit fly.

Agricultural exports consistently make a large positive contribution to the U. S. balance of trade. The USDA Economic Research Service's statistics for the fiscal year 1993/94 showed the value of U.S. exports to the world market for apples, cherries, peaches/nectarines, and strawberries was \$650 million; cotton, \$2.3 billion; oak logs \$130 million; and walnuts (in shell) \$86 million. The export market values for these commodities to countries requiring methyl bromide treatment totalled \$232.8 million (\$101, \$106, \$24, and \$1.8 million respectively). These market values express the overall dimensions of trade in these commodities under current conditions.

Stored agricultural food products include a wide variety of dry foodstuffs, principally cereal grains, oilseeds and legumes, grain products, dried fruit and nuts as well as durable products such as, timber and timber-containing products, and various artifacts. These products are often stored for long periods of time and are treated with methyl bromide for control of a number of domestic pests. Insect and mite pests can breed on these materials during storage. Pests may also be present at time of harvest, and persist in storage or during transportation. Control of pests infesting stored commodities is essential to keep commodity losses to a minimum, to maintain quality and prevent damage, and prevent the spread of pests between countries. In 1993/94 the estimated value of dried fruits and nuts alone was in excess of \$4 billion.

Structural fumigation of food production and storage facilities (mills, food processing, distribution warehouses), non-food facilities (dwellings, museums), and transport vehicles trucks, ships, aircraft, rail cars) are very reliant on methyl bromide for control of a large number of pests. It is used either on an entire structure or a significant portion of a structure. Fumigation is utilized whenever the infestation is so widespread that localized treatments may result in re-infestation or when the infestation is within the walls or other inaccessible areas.

The current extent and importance of methyl bromide use and the potential impacts that the 2001 phaseout poses for American agriculture necessitate a major effort to ensure that American farmers can continue to raise and market their crops. USDA has directed its resources and expertise, with the support of Congress and

in cooperation with growers, to conduct an ambitious research program to identify and develop alternatives to control the pests currently controlled by methyl bromide.

USDA's Agricultural Research Service is seeking alternatives for methyl bromide through research on a variety of approaches which include: 1) new cultural practices, 2) improved host-plant resistance to pests and diseases, 3) biological control systems using beneficial microorganisms, and 4) less harmful fumigants. For postharvest treatment, alternatives being investigated include: 1) creation of pest-free agriculture zones, 2) physical methods such as hot or cold treatment or storage in modified atmospheres, and 3) alternative fumigants.

ARS has for many years devoted significant research resources to approaches with potential for replacing methyl bromide. Since the U.S. Environmental Protection Agency (EPA) announced the phaseout for methyl bromide, ARS increased its efforts to find alternatives. Spending for methyl bromide alternatives increased from \$7.4 million in FY 1993 to the current \$13.1 million in FY 1994 and FY 1995. This spending supports 42 scientists years involving 46 projects. In addition, ARS has allocated \$512,000 in extramural cooperative research projects with state universities and is preparing to release an additional \$150,000 from lapsed salaries in the next few weeks.

The President's FY 1996 budget requests \$13 million for USDA to continue an aggressive research program to develop alternatives. This research is augmented by research funding from grower groups and EPA. USDA and EPA have also sponsored an international symposium for scientists working on methyl bromide alternatives to present their results and discuss progress in finding effective alternatives. In addition, we are working with EPA's Office of Pesticide Programs to ensure that any alternatives that need to be registered by EPA will receive expedited treatment.

Our efforts have already led to several promising options as alternatives for preplant uses. The search for quarantine options has not to date yielded a similar array of options. However, significant progress has been made in the capture and recycling of methyl bromide in quarantine uses that have drastically reduced emissions. Furthermore research has led to possible advances in field application techniques that will also enable us to reduce emissions to the atmosphere and reduce environmental impacts.

Despite our confidence in the efforts of our researchers, USDA also recognizes that there are a number of real world factors that affect our ability to find alternatives. We recognize that a wide variety of crop applications spread over a diverse set of geographic conditions will have to be found and that no single practice will substitute for all those uses. We also know that a genuine alternative for farmers must be efficacious, cost effective and available for efficient incorporation to standard agricultural practices. Although EPA has committed to expedited registration, the approval process for a new use or new product requires that registrants conduct and submit a number of studies that EPA must review by the latest standards. Even with the best of intentions, EPA's registration process often requires a deliberate and lengthy review. In addition, the time to secure approval for quarantine practices for international trade is most often measured in multiple years until decisions are made by importing countries.

The bottom line is that we must be realistic in recognizing that the final test of an alternative is its adoption for field application. Even with the sincere commitment of USDA, EPA, and growers to develop alternatives we may still find situations where effective alternatives will not be available for important uses by the time the phaseout takes effect. The consequences of that eventuality would pose significant competitive disadvantages for American agricultural production and trade, if we do not have an effective safety valve for essential uses both domestically and internationally.

Let me be clear, Mr. Chairman, that USDA fully supports efforts to prevent adverse environmental and human health impacts from the degradation of the stratospheric ozone layer. We believe that international environmental progress is possible through unified action by all countries by building on the successes of the Montreal Protocol. Our hope is that domestic policy issues can be worked out so that we are not hampered on the one hand in achieving international consensus on environmental protection and on the other hand by possibly putting our agriculture and trade at a significant competitive disadvantage.

This Administration has consistently maintained that a vital economy and a healthy environment can and should go hand in hand. The debate over methyl bromide regulation offers an opportunity for all of us to work together in achieving those goals. Mr. Chairman, we appreciate your interest in initiating the debate on this issue and we look forward to working with you in Congress, EPA, and other stakeholders to craft a reasonable solution to this problem.

Mr. Chairman, this concludes my statement. I will be glad to respond to questions from you or other members of the Subcommittee.

Mr. BARTON. Thank you. I want to thank the panel for all being within the time limit we appreciate that.

The Chair recognizes himself for the first round of questions.

Ms. Nichols, I don't want to belabor the point on your charts, but the previous panel indicated that there is no model currently in use that can predict the future with regard to trends in ozone and yet your chart very confidently predicts an increase if we continue to ban out, if I'm reading it right, the next 60 years. How do you reconcile that?

Ms. NICHOLS. The source of this chart is the science assessment. I listened to the testimony of the previous panel and I believe that they were responding to a question about a more complex kind of modeling of individual compounds, but that this was the consensus view about where the overall levels would be without actual—

Mr. BARTON. I'm not going to argue that it might be a consensus view, but based on what they told me, I would argue that it's not based on a model that actually has shown that it can predict the future.

Ms. NICHOLS. That is—I won't dispute that.

Mr. BARTON. OK. You testified in your written testimony that the EPA is very willing to make exceptions if there are no alternatives for methyl bromide and the committee is very appreciative of that testimony. I want to read you a comment from the Deputy Secretary of Agriculture back in 1993, directed to Carol Browner on essential uses.

It says if methyl bromide is listed as a class one substance pursuant to Section 602 of the Clean Air Act amendments, and its production consumption is phased out, EPA does not have the authority to allow continued production consumption of methyl bromide under the essential use provision of the Clean Air Act.

Section 604 of the Clean Air Act authorizes the administrator of EPA to allow the production and consumption of certain specified class 1 substances for certain specified essential uses beyond the date of termination of the production and consumption of specified substances. Methyl bromide is not one of the substances identified in 42 U.S. Code Section 6761-C, which the Administrator of EPA may exempt from the termination of production and consumption because of an essential use.

So those of us that are not anxious to ban methyl bromide are very thankful that you're now willing to look at an exception for essential uses in agriculture, but according to the Deputy Secretary of Agriculture, Mr. Rominger, back in 1993, you don't have the legal authority to do that. So is this another example of where you're willing to do the right thing, but we need to change the law so that you can do what you want to do?

Ms. NICHOLS. Mr. Barton, the letter from Deputy Secretary Rominger indicates his view and I presume it's his department's view about the interpretation of the Clean Air Act does not represent the EPA's position on the interpretation of the Clean Air Act.

I have not sought nor do I have to provide to you today a statement of the EPA's legal authority in this matter. I have consulted

with our Office of General Counsel about the statement that we provided to you today and they have indicated that they are willing to work with us to develop essential use provisions.

Now—

Mr. BARTON. We are appreciative of that. I'm not disparaging of that, but we do have one legal opinion from the distinguished gentleman to your left's agency that good intentions are just that. And that methyl bromide is not one of the substances listed that can be exempted and I mean obviously we could get 42 U.S. Code Section 7671-C and read it and see. If in fact the Department of Agriculture's opinion is correct, I would hope that you would allow us, when we do our reform bill, to work with you to provide the legal authority to do what you say you want to do.

Ms. NICHOLS. Well, Mr. Chairman, with respect to every other compound that was listed, there was a precise set of criterion factors for essential use exemptions and we believe that that's how we ought to approach this issue that whether EPA itself exercises authority or whether we seek additional authority through the Congress. Either way we would need to have a set of carefully crafted standards and procedures for doing that and that we need to have a process by which those can be developed just as they were for the others.

We at EPA are committed to moving forward to initiate that sort of a process working with our colleagues at USDA and obviously with our stakeholders to try to develop those criteria.

Mr. BARTON. And before I recognize Mr. Wyden, Mr. Elworth, do you on behalf USDA concur with the statement of the Deputy Secretary several years ago in this area? It's still your department's position that there's not the legal authority to grant the relief on an essential use basis.

Mr. ELWORTH. That was the statement of the Department at that time, yes, sir. I am certain that it got clearance through our general counsel's office and through the entire department.

Mr. BARTON. Could you provide for the committee if it continues to be your department's—I mean, obviously general counsels can offer different opinions at different times so we would like to have for the record what the Department's position is today.

Mr. ELWORTH. OK. I would be glad to do that.

[The information referred to follows:]



DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

Honorable Joe L. Barton
United States House of Representatives
2264 Rayburn House Office Building
Washington, DC 20515

Dear Congressman Barton:

On August 1, 1995, I testified before the Subcommittee on Oversight and Investigations of the Commerce Committee at a hearing on the Implementation and Enforcement of the 1990 Clean Air Act Amendments, focusing on the Title VI provisions relating to Stratospheric Ozone Protection. At the hearing, you asked whether the Department of Agriculture continues to hold the opinion expressed in a May 17, 1993, communication from Deputy Secretary Richard Rominger to Environmental Protection Agency (EPA) Administrator Carol Browner as to the EPA's legal authority for granting essential use exemptions for methyl bromide under the Clean Air Act. In answer to your question, the Department has not found cause to revise the opinion expressed in the May 17, 1993, comments.

Please feel free to contact me if you or other members of the Subcommittee have additional questions.

Sincerely,

A handwritten signature in dark ink, appearing to read "Larry Elworth", with a long horizontal flourish extending to the right.

Larry Elworth
Special Assistant for Pesticide Policy

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DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

MAY 17 1993

The Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W. (A-100)
Washington, D. C. 20024

Dear Administrator Browner:

This letter is in response to the U.S. Environmental Protection Agency's (EPA) proposal to classify methyl bromide as a Class I ozone-depleting substance which would result in its termination of production and consumption in the year 2000. The proposal was published in the Federal Register on March 18, 1993 [58 Federal Register, 15014, March 18, 1993], and the comment period was extended to May 18, 1993. These comments are provided on behalf of the U.S. Department of Agriculture.

Methyl bromide is very important to United States agriculture. It is used widely as a soil fumigant and in post harvest and quarantine treatments to control a variety of pests on numerous crops. For many uses there are no alternative chemicals or other viable treatment options for its replacement. The loss of methyl bromide would be costly to individual agricultural producers and to consumers, thus having a detrimental impact on the U.S. economy.

USDA has been closely following the issues associated with classifying methyl bromide as an ozone-depleting chemical under the amended Clean Air Act (CAA), an action which would require its removal from production and use. USDA recognizes the importance of protecting stratospheric ozone, but we believe that the decision process on methyl bromide's future use in agriculture would benefit greatly from having better information. Methyl bromide affects a broad domestic and international community of users, and in spite of over 15 years of intensive research efforts, we have been unsuccessful in finding efficacious and safe alternatives.

USDA's primary concerns regarding the proposed rule include: 1) the fragile scientific data base which is being used to support methyl bromide's role in depleting the ozone, 2) the economic impact to the U.S. agricultural economy of banning or phasing-out the use of methyl bromide in absence of viable alternatives for post harvest/quarantine and soil fumigation uses, 3) the short time period (approximately 6 1/2 years) for developing alternatives, and 4) the negative impact its removal would have on international agricultural trade, particularly the U.S. imports and exports. Our specific comments are included in the attached documents, USDA Comments on the Proposed Rule on Methyl Bromide and The Biological and Economic Assessment of Methyl Bromide.

A report released from the Department of Energy (DOE), Office of Energy Research, entitled "Overview of the DOE Atmospheric Chemistry Program's Ozone Project", further substantiates

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our concerns regarding the more important scientific uncertainties associated with the global ozone issue. The DOE report states that "In particular, we are unable to predict with confidence the ozone-depletion potentials of existing halocarbons, replacement halocarbons, and releases from other industrial emissions (including nitrous oxide and methyl bromide from agricultural activities)...". The uncertainties identified in the DOE document do not differ significantly from those of the United Nations Environment Program's Scientific Assessment Panel. However, like the decision made under the Montreal Protocol, DOE recognizes that the data are insufficient for decision making and has recommended that additional data are needed to clarify the many areas of uncertainty. We understand that EPA has this information and will take it into consideration before making its final decision.

In view of the UNEP assessment report, the recent DOE document, and the actions taken by the Parties to the Protocol in Copenhagen, USDA feels that the most appropriate course of action would be to ensure that the major data gaps are filled before determining the final fate of methyl bromide. We would encourage EPA to join the other Parties to the Protocol and ensure that a thorough and comprehensive study is carried out over the next two years to clarify the existing uncertainties. All parties can be better served by having sound science as the basis for making important decisions, such as with methyl bromide. Once these data are in and evaluated appropriate regulatory decisions can be taken.

Should EPA proceed with classifying methyl bromide as a Class I substance and in view of the lack of alternatives, particularly for quarantine, we believe that it is imperative that the proposed termination date for production and consumption be in the year 2001 (the full seven years subsequent to listing) instead of the proposed year, 2000. Also, it is unlikely that alternatives will be available before the year 2001, and we strongly encourage no interim cuts in production and consumption before the mandatory termination date 2001.

We appreciate the opportunity to comment on this document, and I would be pleased to discuss these and other issues surrounding this important matter.

Sincerely,


 Richard Rominger
 Deputy Secretary

**U.S. DEPARTMENT OF AGRICULTURE'S
COMMENTS ON
PROPOSED RULE ON
METHYL BROMIDE
[58 FEDERAL REGISTER 15014, MARCH 18, 1993]**

INTRODUCTION

The U.S. Department of Agriculture is pleased to provide comments on the U.S. Environmental Protection Agency's (EPA) proposed actions under the Clean Air Act (CAA) to classify methyl bromide as a Class I ozone depleting chemical with a subsequent mandatory termination of production and consumption by the year 2000. Methyl bromide is very important to United States agriculture, and it is widely used as a soil fumigant and in post harvest and quarantine treatments to control a variety of pests on numerous crops. For many uses there are no alternative chemicals or other viable treatment options for its replacement. The loss of methyl bromide would be costly to individual agricultural producers and to consumers, thus having a detrimental impact on the U.S. economy.

Our primary concerns regarding the proposed rule include: 1) the fragile scientific data base which is being used to support methyl bromide's role in depleting the ozone; 2) the economic impact to the U.S. agricultural industry from banning or phasing-out the use of methyl bromide in the absence of viable alternatives for post harvest/quarantine and soil fumigation; 3) the short time period (approximately 6 1/2 years) for developing alternatives; and 4) the negative impact its removal would have on international agricultural trade and the U.S. agricultural economy. We believe that there are insufficient data to support the proposed action on methyl bromide at this time. Our concerns are addressed in the following paragraphs.

1. UNCERTAINTIES WITH THE SCIENCE WHICH SUGGEST METHYL BROMIDE IS AN OZONE DEPLETOR

The June 1992 United Nation's Environment Program (UNEP) Scientific Assessment Update for methyl bromide stated unequivocally that "The current state of scientific knowledge concerning bromide compounds in the atmosphere is considerably less developed than the corresponding understanding of chlorine compounds." The document was peer reviewed by many of the world's leading atmospheric scientists who unanimously agreed that there are many uncertainties associated with the science related to the ODP for methyl bromide. Therefore, they identified and recommended numerous highest priority, near-term research projects that would enable significant improvement over the next few years in the understanding of the role and sources of methyl bromide in ozone depletion.

At the November, 1992, Copenhagen Meeting of the Parties to the Montreal Protocol, the Parties took the recommendations by the Science panel into consideration and concluded that given the paucity of data to support an ODP and the importance of the compound to agriculture worldwide, no level of phase-out can be justified at this time. Instead, the Parties agreed to list methyl bromide with an ODP of 0.7 as a "best estimate" and conduct an in-depth study over the next two years. The data will be reevaluated at the completion of the study.

A report released from the Department of Energy (DOE), Office of Energy Research, entitled "Overview of the DOE Atmospheric Chemistry Program's Ozone Project", further substantiates our concerns regarding the more important scientific uncertainties associated with the global ozone issue. The DOE report states that "In particular, we are unable to predict with confidence the ozone-depletion potentials of existing halocarbons, replacement halocarbons, and releases

From other industrial emissions (including nitrous oxide and methyl bromide from agricultural activities)...". The uncertainties identified in the DOE document do not differ significantly from those of the United Nations Environment Program's Scientific Assessment Panel. However, like decision made under the Montreal Protocol, DOE recognizes that the data are incomplete for decision making and has recommended that additional work are needed to clarify the many areas of uncertainty. We understand that EPA has this information and will take it into consideration before making its final decision.

In view of the UNEP assessment report, the recent DOE report, and the actions taken by the Parties to the Protocol in Copenhagen, USDA feels that the data do not support classifying methyl bromide at this time. We would encourage EPA to join the other Parties to the Protocol and ensure that a thorough and comprehensive study is carried out over the next two years to fill the existing data gaps. We believe that all parties can be better served by having sound science on which to base important decision such as with methyl bromide. Once these data are in and evaluated appropriate regulatory decisions can be made at that time.

Should EPA proceed with classifying methyl bromide as a Class I substance and in view of the lack of alternatives, particularly for quarantine, we believe that it is imperative that the proposed termination date for production and consumption be in the year 2001 (the full seven years subsequent to listing) instead of the proposed date, the year 2000. Also, it is unlikely that alternatives will be available before the year 2001, and we strongly encourage no cuts in uses for methyl bromide before the mandatory termination date, 2001, for production and consumption.

In conducting this comprehensive research effort, USDA would recommend three top priority research areas. These are: 1) the tropospheric removal process, 2) atmospheric removal and the rate of formation of reservoir species such as hydrogen bromide (HBr), and 3) quantification of natural and anthropogenic sources for methyl bromide.

UNEP and EPA have assumed that the hydroxyl (OH) radical is the only significant tropospheric loss mechanism. Significant amounts of methyl bromide are likely to be removed from the atmosphere by ocean absorption as well as deposition, adsorption, and degradation by soils and vegetation. Although there are no data have been compiled at present to confirm these additional removal processes, the 1992 UNEP Scientific Assessment Update identified them as highly suggestive that these compounds may be present and at measurable quantities. If these compounds are present, there would be less bromine available to deplete ozone. The UNEP 1992 Scientific Assessment's estimated ODP for methyl bromide is based on the assumption that this pathway is zero. Model calculations by Poulet and Sze which assumes approximately 10 percent of the $\text{BrO} + \text{HO}_2$ reaction proceeds to HBr can yield an appreciably lower ODP for methyl bromide and in certain cases less than 0.2.

The oceans are considered to be the major natural sources for methyl bromide, and USDA strongly supports the recommendation by the UNEP Science Assessment Panel to quantify the levels of methyl bromide in the atmosphere which occur from natural and anthropogenic sources. Currently, USDA is conducting research on technologies to quantitate and reduce methyl bromide from agricultural emissions. While we agree that anthropogenic emissions should be decreased, we question if reduction of man-made sources would have a significant impact on ozone depletion in view of the quantities emitted from natural sources.

2. POST HARVEST/QUARANTINE

Methyl bromide is one of the few fumigants left for insect disinfestation and is the fumigant of choice because of its ease of use and the relatively short time required for fumigation (2-24 hours). It is a broad spectrum, penetrative fumigant which controls most insects, plant diseases, nematodes, and weeds. Many commodities become infested and must be fumigated, not only

to protect the commodity from insect pests but also to prevent secondary effects caused by fungi or other microorganisms. The implications of the loss of methyl bromide worldwide without availability of suitable and economical alternatives are severe for both developed and developing countries. Such a loss would have implications for international commerce both from the standpoint of application of methyl bromide for commodity protection and the more rigid requirements for quarantine treatments. Quarantine treatments are designed to exclude specific pests from countries not having that pest(s). Many of these commodities are of high value and become even more valuable with value added costs. There are no other chemicals available that provide the physical and chemical characteristics of methyl bromide that would make them useful as alternative commodity treatments. The only other fumigant available is phosphine, principally used on grains. Phosphine is not a suitable alternative for many agricultural commodities because of severe phytotoxicity and the extended times (up to seven days) required to attain insect control. Industries such as the dried fruit industry are dependent on fumigation times of less than 24 hours in order to maximize processing efficiency in preparation for critical markets. A seven day fumigation time would cause a severe reduction of processing efficiency, eliminate markets, and have adverse economic consequences for the industry. Although alternatives are available for a few commodities they are accompanied by higher application costs, more limited usefulness, generally slower action, and require a high level of technical sophistication which is unavailable in many developing countries.

Possible alternative quarantine treatment processes include chemical fumigants, contact pesticides, insect growth regulators, hot water dip, hot air, cold treatment, and radiation. Research has been conducted on all alternatives. To date, they are used on a limited number of commodities, usefulness, generally slower action, and require a high level of technical sophistication which is unavailable in many developing countries.

Possible alternative quarantine treatment processes include chemical fumigants, contact pesticides, insect growth regulators, hot water dip, hot air, cold treatment, and radiation. Research has been conducted on all alternatives. To date, they are used on a limited number of commodities, primarily tropical fruits from developing countries. Often they require extended time periods or require specialized equipment and highly trained personnel to use effectively; some require high levels of energy. Physical alternatives are phytotoxic to many fruits and vegetables because they do not tolerate the extreme heat or cold temperatures necessary to control the numerous quarantine pests. Phytotoxicity will result in reduced shelf life and marketability of the commodity. Once a treatment is developed, appropriate facilities must be developed and built to handle the volume of commodities.

Wherever possible, alternative treatments are used; however, very few commodities presently treated with methyl bromide can be satisfactorily treated with present or projected alternative processes. Further, it is unlikely that any can be developed, registered and operationally in place in the next 5-7 years. Different temperature thresholds among different insect species of the same genus mandate that treatments be developed for each species. For example since ethylene dibromide was canceled in 1987, only a small percentage of mangoes from specific countries have been found to be treatable with a physical process. No fumigants were found to be acceptable including phosphine, ethylene oxide, sulfuryl fluoride and numerous other organic compounds. Hot water treatment provided the best possibility as an alternative. Research was undertaken by USDA, various universities and private industries in the U.S. and throughout the world. It was found that because each species of a quarantine pest and each variety of mango have different temperature thresholds, research must be performed individually on each pest and mango variety. None of these physical processes can be used on mangoes containing internal feeders (i.e. mango seed weevil). For some commodities treated in quarantine with methyl bromide and where no alternative is feasible, radiation may be considered as an alternative. Logistically this alternative is extremely difficult, not just from the standpoint of consumer acceptance, but also from a legal perspective. For example, radiation is illegal in some U.S.

states as well as with a number of our trading partners, e.g., Japan, New Zealand, and Colombia. There is no assurance that this situation will change. It is likely that non-chemical alternatives for quarantine will require a combination of treatments or a systems approach. However, it is unlikely that these alternatives will be capable of handling the import or export volumes or meet the time elements to coincide with the short shelf-life of most perishable commodities.

Methyl bromide is used as a quarantine or post harvest treatment for many agricultural commodities exported from the U.S. The quarantine treatments are required by regulations of the importing countries. Negotiating new treatment with our trading partners even after the scientific data are available is a process requiring many years before it is successful.

An economic analysis was performed to measure the economic impact in the United States of a ban on methyl bromide fumigated imports of nine selected fruits (apricots, grapefruit, grapes, lemons, oranges, peaches/nectarines, plums, and tangerines). For these nine commodities, estimated net losses resulting in the United States over five years from a ban on imports of these items range from \$1,681 to \$1,707 million (See attachment, The Biologic and Economic Assessment of Methyl Bromide, page 66). In general, the reduction in supply caused by bans placed on imports of these commodities results in increased prices which favor producers and harm consumers; in this case, consumer losses outweigh producer gains. Estimated total U.S. producer gains range from \$3,006 to \$3,290 million over five years. Over 70 percent of U.S. producer gains accrue from plums. Estimated total U.S. consumer losses range from \$4,688 to \$4,997 million. Approximately 75 percent of consumer losses are attributed to grapes, peaches, and nectarines. An additional 14 to 15 percent of all consumer losses can be attributed to plums.

Severely restricting methyl bromide for quarantine uses would have a negative effect on the United States balance of trade and trade parity with foreign countries not bound by the CAA provisions. Foreign exporters may continue to treat in their country for export to the United States and other foreign markets requiring treatment, but we would not be able to export to them. This advantage would enable them to take away long established markets because we do not have the means to provide quarantine security.

USDA support efforts to encourage research on recycling methyl bromide or trapping and destruction of the chemical after use. However, current available recycling schemes are suitable only for laboratory scale use. There are no recycling technologies available for quarantine treatments at this time due to the quantities of methyl bromide used in individual treatments, characteristics of the sorption process in packing and crating, and aeration requirements for fresh produce and nursery stock. Should research produce practical recycling methods suitable for agricultural uses, recycling will be quickly adopted both for economic and environmental reason; reliance or requirements for these practices must be related to availability.

Based on our current knowledge and the investment necessary, it is most unlikely that any broad spectrum alternative to methyl bromide will be developed, much less registered within the next 10 years.

3. SOIL FUMIGATION

Based upon a survey of the States to determine the most critical uses of methyl bromide, and where these uses occurred, USDA conducted a focused soil fumigation assessment that accounted for approximately 75 percent of the agricultural uses of methyl bromide in the United States. This study (see attachment, The Biologic and Economic Assessment of Methyl Bromide) includes an assessment of the benefits of methyl bromide used for soil fumigation on 21 crops in California, Florida, Georgia, North Carolina and South Carolina. In addition, data were included from Kentucky on use of methyl bromide for soil fumigation in tobacco production and from Florida for post harvest treatment of citrus. These soil fumigation uses represent 80 percent of the U.S. methyl bromide use to control soil pests.

It is estimated that the annual economic loss to U.S. consumers and producers of agricultural

commodities included in the soil fumigation study would be in the range of \$0.8 to 1.1 billion using currently registered alternatives. Crops most severely affected by a ban on soil fumigation use of methyl bromide would be fresh market tomatoes, ornamental, tobacco, peppers and strawberries. U.S. consumers would bear a significant portion of the loss because of higher prices, while U.S. producers would lose market share to foreign producers. The economic loss is underestimated 20 percent of the soil fumigation uses were excluded from the study.

The USDA assessment estimated economic losses only for the initial year of regulatory removal because of the complexities of addressing accumulative effects of crop and market losses, expanding pest infestations, and less acreage available to produce the crops in the future. Economic losses could increase in the future as pest infestations increase due to less effective controls. However, it was apparent that U.S. production of some crops would decline dramatically, and U.S. producers would lose market share to foreign producers.

Through inputs from qualified specialists, we have confirmed that current chemical and non-chemical alternatives are incapable of providing sufficient benefits to replace methyl bromide. Currently available fumigant alternatives are metam sodium, 1,3-D (not registered in California), and dazomet (registered for tobacco and a limited number of non-food uses). The registration of the most effective alternative fumigant alternative, Vortex, is being voluntarily canceled by the registrant. There is no evidence of a current fumigant chemical alternative under development nor that one could be successfully formulated. It is highly improbable that a single new chemical formulation will be developed as a total fumigant replacement. Even if this were possible, it would take an estimated ten years at a total cost ranging between \$50-70 million. Industry would need to confront the regulatory burdens inherent in new chemistry including the environmental and safety guidelines that are required by registration by the U.S. Environmental Protection Agency. Producers would have to rely on multiple treatments of insecticides, nematocides, fungicides and herbicides; this is not practical from an environmental or economic perspective. Nonchemical practices such as crop rotation are possible alternatives but generally require more land.

4. Legal Comments

a. Essential Uses

If methyl bromide is listed as a Class I substance pursuant to section 602 of the CAA, as amended (42 U.S.C. § 7671a), and its production and consumption is phased out, EPA does not have the authority to allow continued production and consumption of methyl bromide under the "essential use" provisions of the CAA. Section 604 of the CAA (42 U.S.C. § 7671c) authorizes the Administrator of EPA to allow the production and consumption of certain specified Class I substances for certain specified essential uses beyond the date for termination of the production and consumption of the specified substances. Methyl bromide is not one of the substances identified in 42 U.S.C. § 7671c which the Administrator of EPA may exempt from the termination of production and consumption because of an essential use.

If a statute specifies express exceptions to its general application, other exceptions not explicitly mentioned are not to be implied in the absence of contrary legislative intent. *Anding v. Glover Construction Company*, 446 U.S. 608 (1980); *In re German*, 898 F.2d 730 (9th Cir. 1990); and *U.S. v. Goldfarb*, 879 F.2d 811 (10th Cir. 1989). There is nothing in the CAA that would indicate that the Administrator of EPA is authorized to exempt substances from termination of production or consumption because of an essential use other than those substances specifically identified in 42 U.S.C. § 7671c.

We believe that an amendment of the CAA would be necessary to provide the Administrator of EPA with authority to exempt essential uses of methyl bromide from the production and

Consumption termination date that would be applicable if methyl bromide is listed as a Class I substance.

B. Removal of a Substance from the List of Class I Ozone Depleting Chemicals

If methyl bromide is listed as a Class I substance pursuant to section 602 of the CAA (42 U.S.C. § 7671a), EPA could possibly remove methyl bromide from the list of class I substances if it later discovers that the basis for including it on the list is faulty.

Section 602(a) of the CAA (42 U.S.C. § 7671a(a)) lists certain Class I substances and sets forth criteria for the Administrator of EPA to list additional substances, by rule, as class I substances under section 602(c) of the CAA (42 U.S.C. § 7671a(c)). Section 602(c)(4) of the CAA (42 U.S.C. § 7671a(c)(4)) provides that no substances referred to in section 602(a) of the CAA (42 U.S.C. § 7671a(a)) may be removed from the list of class I substances.

If methyl bromide is added to the list of Class I substances, it would be added pursuant to section 602(c) of the CAA (42 U.S.C. § 7671a(c)). Therefore, if methyl bromide is listed as a class I substance, there would be no explicit Congressional prohibition on EPA's removing methyl bromide from the list of Class I substances.

It is reasonable to conclude that Congress intended to limit EPA's authority to remove substances from the Class I list only with respect to those Class I substances specified in section 602(a) of the CAA (42 U.S.C. 7671a(a)). However, a reasonable argument can also be made that, since the CAA is silent with respect to EPA's authority to remove substances from the list of class I substances under section 602(c) of the CAA (42 U.S.C. § 7671a(c)), Congress did not intend to give EPA authority to remove any substance from the list of class I substances once the substance is on the list of class I substances.

c. Labeling requirements

USDA concurs with EPA's conclusion that agricultural processes be excluded from the definition of manufacture and would therefore not be subject to the labeling requirements.

Section 611 of the CAA (42 U.S.C. § 7671j) requires, with certain limited exceptions, the labeling of products manufactured with a process that uses a Class I substance. However, the notice of proposed rulemaking in question states that it is EPA's intent to distinguish between an "agricultural process" and a "manufacturing process" and that, for the purposes of 42 U.S.C. § 7671j, EPA defines "manufacture" as "the mechanical or chemical transformation of material or substances into new products or to assemble component products." (See 58 Fed. Reg. 15038).

The CAA does not define the term "manufactured with." EPA is charged with the administration of the CAA and specifically with promulgating regulations to implement the labeling requirements of section 611 of the CAA (42 U.S.C. § 7671j). Therefore, EPA may reasonably construe the meaning of the term "manufactured with" as used in section 611 of the CAA (42 U.S.C. § 7671j), and any rational construction will be upheld by a reviewing court, if that construction is challenged. *Young v. Community Nutrition Institute*, 476 U.S. 974 (1986); and *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984).

The construction given by EPA to the term "manufactured with" in section 611 of the CAA (42 U.S.C. § 7671j) would not include the use of methyl bromide to grow, store, harvest, or transport agricultural products or to eliminate pest or disease risks associated with agricultural products. We believe that EPA's construction of the term "manufactured with" as used in section 611 of the CAA (42 U.S.C. § 7671j) is reasonable, and we can find nothing in the CAA to indicate that EPA's construction of the term conflicts with Congressional intent.

Mr. BARTON. The Chair would recognize Mr. Wyden.

Mr. WYDEN. Thank you. All of you have given excellent testimony. I want to start, if I could, with you, Ms. Nichols.

It seems to me the Ozone Protection Program is a program where markets have worked. I consistently look and everybody says the sky is going to fall, the CFCs would be gone and we would never have anything as an alternative and we came up with one there. I guess it is HFC 134-A. The same thing was said with halons. Everybody said catastrophic consequences. We're not going to be able to extinguish fires and all the rest.

Is there any evidence to suggest that the market won't work in this case by 2001. What information can you give us that suggests that it is just going to be impossible to get an alternative here by the year 2001?

Ms. NICHOLS. Well, Mr. Wyden, as you've indicated, we have a good track record using standards and phaseouts to show that it is possible for science to work. We have in the past granted a couple of very limited essential use exemptions. One is for metered dose inhalers. Another one is for the cleaners that are used on missiles and on the space shuttle so there are cases where science simply did not come up with a viable alternative for those very limited uses, but it's our position that if we had granted a blanket exemption or had wavered from the course early, we wouldn't have the whole—

Mr. WYDEN. But there is no evidence today to suggest that it's going to be impossible to get this done by 2001, is there?

Ms. NICHOLS. No there is no such evidence and in fact increasingly we are building up the case that for various uses there are viable alternatives. A report that EPA has just put out on 10-K studies that are just a small snapshot of work that EPA has funded, has done in the field, has come up with some uses for soil. Structurally these are not going to cover all applications. They cover very limited applications, but they are indicative of what we believe is possible.

Mr. WYDEN. Now, in your testimony I guess you indicate that the Office of Pesticide Programs is going to give priority review to alternatives to methyl bromide that come forward with registration. We are pleased to hear that. I think you may have not been here for it, but Mr. Pavich talked about what sure sounded to me like some bureaucratic water torture when he basically was out there with this sesame stock as a natural pesticide. He wanted to get it registered and basically just got pounded by bureaucracy and red tape.

What are you all willing to do to actually make sure that these alternatives get expedited review and really get fast tracked for registration?

Ms. NICHOLS. I have talked to my colleagues in the Office of Pesticides and Toxics and they have indicated that they have a streamlined process which is available particularly for substitutes for other problematic compounds. Methyl bromide itself is registered and is subject to registration and a lot of concerns have been raised about it. So it's my understanding that substitutes for methyl bromide would undergo a much shorter review. I don't have

a precise time limit, but I understand the number of steps they have to go through.

Mr. WYDEN. Why don't you send us that for the record because I think we have got to be able to show these people that there are going to be new procedures and new focus and make sure that people aren't going to go through these kind of ordeals that run longer than the Trojan War.

Now, one question for you, if I could, Mr. Elworth. We understand that USDA received \$13 million in fiscal year 1995 for research on methyl bromide alternatives, but that the bulk of the money was kept in-house in the Agricultural Research Service.

Now, over at Oregon State which is a bit outside of our district, but lots of our folks work there and are interested in their agricultural work, they have said that they are unable to get even \$25,000 for research to look at methyl bromide alternatives.

Is it going to be possible for your department to have more focused, cooperative efforts with private and university research efforts in the future so that we can get a larger array of these kinds of scientists involved?

Mr. ELWORTH. I was at a meeting at the end of last week that the Deputy Secretary held specifically with people from grower groups to discuss this very issue. As perhaps you know, the money has been allocated to USDA through the Agricultural Research Service, which is our in-house operation. But obviously a lot of the promising work is being done at specific universities and is not necessarily—not necessary to start new programs within USDA.

As I understand it, Under Secretary Stauber has made available or will make available in the next couple of weeks roughly \$650,000 specifically to be used in cooperative agreements with land grant universities and others. That's an option we continue to have through cooperative agreements.

Mr. WYDEN. So \$650,000 out of the \$13 million is going to be used. Do you think that's sufficient? It seems to me, again, with the kind of focus that the Congress wants, that we want to show the growers is going forward that it still looks like an area that's got to be beefed up. Is that sufficient?

Mr. ELWORTH. I don't know exactly what the proper mix of short term versus long term is. You raise an important point that we need to look not only at long-term solutions. The long-term solutions to these are long-term breeding programs, the development of resistance in a whole host of plants that are susceptible to pests that methyl bromide controls. Those are extremely long-term projects that can't be done in the short term. We need to refocus obviously on the needs that growers have for short-term fixes as well.

Mr. WYDEN. The point is we've got a 2001 deadline so we've got to go at this aggressively. Clearly we have got to look at the long term. I want it understood that we need to have, in my view, a more aggressive partnership between these universities, private sector efforts and your department.

And Mr. Chairman, I appreciate the extra time.

Mr. BARTON. Thank you. I might just, before I recognize Mr. Burr, I am told that the State Department was able to spend \$114 million to implement the Montreal Protocol.

Would you be willing to let some of that money be reprogrammed to the Agricultural Department so they could do research in conjunction with the EPA to come up with an alternative. Since they only have \$13 million of which only \$650,000—

Mr. MILAM. Well, I mentioned, Mr. Chairman, that we were already very short of money for the Montreal Protocol and for all of our other environmental objectives. We are going to be \$30 million in arrears to the multilateral fund at the end of this year. So I suspect it's a matter of parceling out the money, but I think we need what we've got and frankly we would like more.

Mr. BARTON. I'm not surprised with that answer.

Mr. ELWORTH. I'd like to thank the chairman for that question.

Mr. BARTON. I thought in an ecumenical spirit we could transfer some of that money over here and help everybody.

The Chair recognizes Mr. Burr for 5 minutes.

Mr. BURR. Thank you, Mr. Chairman. Ambassador, welcome. In your testimony, you stated that you planned to support the current caps and the current phase-out schedule on HCFCs for developed countries in the upcoming working group. Now, some of the work that my staff has done suggests that certain European countries are going to be pressing for higher restrictions on HCFCs. What would your position be if you got there and were confronted with that?

Mr. MILAM. Well, Congressman Burr, I think that our position will be to hang in there with our position. We are going into there, one, with very firm positions on HCFCs and on methyl bromide. The logic of our positions—both of our positions is overwhelming. There will be countries—I mean, this is not—everybody has their own sort of objectives and we will face, I think, some pressure on HCFCs from some of the other countries. But I don't think that there will be a heavy majority of countries that will be pushing us on HCFCs so I think we're going to hang in there. I think we'll probably come out OK on that.

Mr. BURR. Can you assure this committee today that our position is not going to change?

Mr. MILAM. This is a negotiation Congressman, I can't—we all have to see.

Mr. BURR. I understand that, Ambassador. But I think—

Mr. MILAM. Let me say this. First of all, I have to tell you that it won't be me who is doing it. I'm moving on, but the facts are that I think our position will—is very—has a lot of logic behind it and a lot of force behind it.

Mr. BURR. Ambassador, I have gone to the Berlin Accord on Global Warming and had people sit in front of me and say we're not going to go do this and all of a sudden when they come back it is totally different.

Let me turn to Ms. Nichols. What's the EPA's position?

Ms. NICHOLS. I would defer to the State Department in terms of our international negotiating position.

Mr. BURR. Do you endorse that they stick to the current—

Ms. NICHOLS. That was the consensus of all the administration.

Mr. BURR. Let me ask, Ambassador, are developing countries held to the same standards that the developed countries are under the Montreal Protocol?

Mr. MILAM. Well, Congressman, the answer is that there's been in all of our protocols, in all of our phase-out schedules, there has been a grace period for developing countries. For CFCs the grace period is still in effect. We don't have the control schedule for them actually negotiated yet. For HCFCs it's still to be negotiated. The answer is, I guess, no, but we intend to make sure that they do phaseout over some reasonable schedule.

Mr. BARTON. Would the gentleman yield on that point?

Mr. BURR. Yes, I would.

Mr. BARTON. What would the impact be if the Congress legislatively put a sense of the Congress resolution in that you should not—you should hold fast and not try to accelerate.

Mr. MILAM. On HCFCs?

Mr. BARTON. Yes, sir.

Mr. MILAM. I think it would—it wouldn't be—we planned to do that anyway, Congressman.

Mr. BARTON. But it would reinforce what you plan to do.

Mr. MILAM. Any resolution from the Congress reinforces things, yes.

Mr. BARTON. I yield back.

Mr. BURR. Ambassador, I'm also informed that China has increased its production of CFCs by over 90 percent. I think one number I saw was 99 percent. What can we in the U.S. do about this?

Mr. MILAM. We can hope that China—that we—I don't know if that number is correct. Incidentally, Congressman, I would have to turn around and ask someone.

Mr. BURR. You aren't the first one this week who questioned my numbers.

Mr. MILAM. If it is or even if it isn't, we do know that in some countries, some developing countries, CFC production is—we need to get more controls over it. So what we intend to do with China and with the other countries of the developing world and CFCs is to negotiate a schedule that they will be required to phaseout under.

Mr. BURR. But under the agreement that we have got, isn't it possible for an increase like that to happen and still be within the framework of what we've agreed to?

Mr. MILAM. An increase in CFC production?

Mr. BURR. For developing countries.

Mr. MILAM. Well, the short run, yes, but in the long run there will be, we hope there will be—we know there will be a phaseout.

Mr. BURR. Mr. Chairman, I will conclude with this statement.

Mr. MILAM. Ms. Nichols has something to add.

Ms. NICHOLS. In this case, Mr. Burr, I wanted to add with respect to China that the Montreal Protocol fund has funded work in China which the EPA has participated in which has led to the phaseout of the use of halons for fire protection and also of CFCs in refrigeration equipment. There's actually refrigerator—CFC-free refrigerators being built now for the Chinese market which is the fastest growing market in the world, that do not use CFCs as a result of the Montreal Protocol fund.

Mr. BURR. And I certainly appreciate the progress that we are making and would make this statement and really my concern on

this comes from the fact that we are here talking about a chemical that affects competitiveness of our agricultural community in this country, our ability to access potentially certain foods in the future.

And have had some very compelling witnesses from the scientific community that suggest that there is in effect, though it be small, that the short term for methyl bromide in the atmosphere leaves very quickly, that some of the things that don't leave as quickly in developing countries are going wild. And in fact I believe we fund over 20 percent of the Montreal Protocol, we, the United States taxpayers, yet—and am I correct there? Ambassador?

Mr. MILAM. I'd have to ask. Twenty-five percent, sir.

Mr. BURR. I stand corrected. I guess, Ambassador, are we getting our money's worth.

Mr. MILAM. Yes, I think so far we've gotten our money's worth and more because if you look at the success we've had in phasing out and the success we've had in pitting together these kinds of phase-out schedules, I'd say we've gotten very much our money's worth.

Mr. BURR. Thank you.

Mr. BARTON. The gentleman's time is expired. Just before I introduce the next gentleman, let me say on getting our money's worth we really haven't focused on some of the CFCs, like CFC-12 or freon, but I used to be able to go to the automotive repair store and get a little can and put it in my car.

I had to put some freon in my 1981 Buick station wagon and have the air conditioner serviced. I couldn't get the freon. It cost \$341. That's a real story. So some of these alternatives may be well available and good theoretically, but in the old days for 10 bucks I could do it myself and now it's \$340 and if I'm lucky it will last until next summer. Of course I could get a new car, too. The Chair would now recognize Mr. Bilbray.

Mr. BILBRAY. Thank you, Mr. Chairman. I guess, Mr. Chairman, that the frustration is that there needs to be some kind of reasonable approach. I remember people buying freon and using it for horns because it was cheaper than using compressed air, so hopefully we'll be able to be more reasonable.

Professional curiosity. What is the miracle replacement for halon? I've been out of circulation for a year, a little thing called a campaign and stuff, but what is the replacement for halon?

Ms. NICHOLS. In this case FM-200. I was looking behind me to see if I can check with my staff. I had the opportunity to represent the EPA at a visit to China and met with the security agency.

Mr. BILBRAY. It's safe to be used in confined spaces with personnel down below?

Ms. NICHOLS. Yes.

Mr. BILBRAY. That's been one I've been watching all along.

Ms. NICHOLS. I'll be happy to provide some more information.

Mr. BILBRAY. I would be pleased: it's a major issue from a lot of points of view.

Ms. NICHOLS. Yes.

Mr. BILBRAY. I would like to, Ms. Nichols, with the testimony and I think a pretty balanced testimony from Dr. Watson, although we may disagree or agree on certain things, point out that there are certain applications that are detrimental to the atmosphere

and there are some that are not, or have minuscule adverse impact. With the way the Clean Air Act exists today and the way that it doesn't reflect our traditional method of approaching air pollution by looking at what are the emissions and adverse impacts, and abandoning that strategy and actually going to a substance-based strategy that doesn't really reflect real life use, shouldn't we be able to look at the differences in the use of substances in a way that reduces the emissions? And why should we necessarily need to have the total ban? I think with these science, with these credentials, doesn't this raise issues that maybe this strategy needs to be looked at?

Ms. NICHOLS. If I could, yes, I agree with you. For example, with CFCs, although there's a ban on new production it doesn't mean that there's literally a ban on the use of CFCs. There is a tax—

Mr. BILBRAY. Get me to methyl bromide, the substance in question—

Ms. NICHOLS. With respect to methyl bromide it seems to me that you could use it, for example, for fumigation in an enclosed space with a recycling capacity so that none of it would be vented to the atmosphere. I believe there's some demonstration work of that sort under way and in fact I think someone told me that there was one in San Diego. And if that's the case—

Mr. BILBRAY. The port of San Diego, importing fruit from South America.

Ms. NICHOLS. So if that is the case, then the use of the methyl bromide in that application would have no impact on the environment.

Mr. BILBRAY. But as of now we are going to terminate the product, and then we will start running into outrageous costs without the benefit that we're aiming at, because we sort of said keep it simple, stupid, but don't confuse us with the facts. My concern here is we get to the fact that the production is going to be curtailed, but there still very probably will be very beneficial uses with very little environmental risk. Under the existing act we've got this conflict with our traditional strategies, of trying to look at outcome, when the current law focuses on progress.

The existing access termination, how do we address this issue unless we go back and try to correct the legislation?

Ms. NICHOLS. I think we have to craft a set of essential use criteria and a process for arriving at those decisions where the uses are essential.

My only message to the committee in my testimony is that we think that we should take the time to work with the stakeholders to craft those criteria and that the actual exemptions need to be given closer in time to the phaseout in order to allow for cost-effective alternatives to be developed. That is what has worked with other ozone depleters and we think it would work.

Mr. BILBRAY. But the existing act doesn't give you that latitude. We have to do it legislatively.

Ms. NICHOLS. That is a question that I am not prepared to answer in that manner at this time. We are not unwilling to work with you on it if we are not successful in solving the problem. We simply are saying that we believe we should explore the alternatives, and that either way, whether we needed legislation or not,

we would have to go through the same exercise in terms of developing the schedules and the process.

Mr. BILBRAY. Dr. Singer pointed out that we should review the cost-benefit analysis on this issue. Do you agree with him?

Ms. NICHOLS. Which analysis? I am sorry.

Mr. BILBRAY. The cost effectiveness, benefit.

Ms. NICHOLS. It is always a good idea to look at cost-benefit numbers over time. I think that his statement, as I understood it, was based on the assumption that you didn't include the effect of the Montreal Protocol. That is, there are original cost benefit numbers about skin cancers prevented which indicate a leveraging of about a thousand to one for our expenses under this provision of the Clean Air Act, an extraordinarily high cost-effectiveness ratio; that those should be discounted because the numbers have changed, and it is true, the Montreal Protocol has been effective. So perhaps that would make marginal reductions look less.

Mr. BILBRAY. Mr. Chairman, I know my time is coming up but I think we have a responsibility that, as I think Dr. Watson would stand up and say, we took dramatic action in addressing this issue a few years ago, and those of us in government respond so quickly at the cry that there is a crisis, that when the same individual is brave enough to stand up and say, maybe there has been an over-kill here, we have just as much responsibility to respond to that and modify legislation to try to bring that dose of reality.

I would just like to close by saying, I think we have experience with the alternatives needing to be put on line. I think, Ms. Nichols, you may remember the problem we had with going to clean fuels in California where we were mandating the clean fuels, but we were not allowing the permitting of the conversion of the refineries to produce the clean fuels.

So our own environmental regulations were standing in the way of our environmental strategies, and it took some real tough pushing; frankly, EPA wasn't helping us a whole lot then, and the South Coast Air Basin wasn't, so I just say that as an ex-member of the air resources board there. But that is where it is going to be a real test of who really stands up for the environment.

Are we are willing to change our environmental regulations to get to an environmental benefit? Or is the regulation so important and so sacred that, sorry, the environment may have to be hurt in the long run because the regulation was so inflexible? And I think that is the challenge we really have to point to. We don't want to have the problems that we had with the clean fuel strategy.

Ms. NICHOLS. We agree with you on the substitutes.

Mr. BARTON. The Chair indicates that there are a number of members not here that have questions that they want to submit in writing. I also have about 15 other questions. I am going to suspend or end the hearing shortly, but I do want to ask one question, though, because it already has been discussed. Mr. Wyden asked the question, and you all may know the answer.

If, in fact, we do phaseout methyl bromide by the year 2001 and other countries do not, agricultural products that come into this country where methyl bromide was used as a fumigant in their growing, would they be allowed in the country or not be allowed in the country?

Mr. ELWORTH. You are going back to the question that Mr. Wyden posed to Mr. Pavich and the fellow from Florida. The question he posed was really two separate issues. The fumigation of fruit coming in from Chile is under U.S. regulation. The impacts from that, where we could not use or could use methyl bromide could be significant. But the use of methyl bromide on tomatoes, say in Florida, is for a totally different use.

It is for a preplant use. That use could continue in Mexico, regardless of whether the Clean Air Act phased out methyl bromide in the United States, and without a quarantine requirement for treatment with methyl bromide of those tomatoes coming into the U.S. and a lot of them come in on trucks to the U.S., you would still be able to import tomatoes into the U.S. while you would not be able at the same time to fumigate any U.S. fruit coming into the United States.

Mr. BARTON. So if I understand the answer, is produce in other countries where methyl bromide was used at some stage could continue to come into the United States.

Mr. ELWORTH. If the methyl bromide use were outside the United States and if we had no methyl bromide treatment as a requirement for importation into the U.S.—

Mr. BILBRAY. Will the gentleman yield on that point?

Mr. BARTON. I would be happy to yield.

Mr. BILBRAY. In other words, in my district, if they brought the truck over and processed in the United States, even where they would recycle it, they couldn't do it because they wouldn't be able to have it in this country, but on the other side, 100 feet south of the border, they could set up a facility there and use methyl bromide, release it into the atmosphere, and then import the tomatoes into California?

Mr. ELWORTH. Under the current arrangement, yes.

Mr. BILBRAY. That is an example where our environmental strategy and our economic strategy has to reflect reality, and that is a reality that we darn well better address. Thank you, Mr. Chairman. I yield back.

Mr. BARTON. Thank you, and we want to thank this panel, again, for being the last panel today. Thank you.

[Whereupon, at 1:05 p.m., the subcommittee was adjourned.]

[Additional material submitted for the record follows.]

QUESTIONS SUBMITTED TO DR. ROBERT WATSON, ASSOCIATE DIRECTOR FOR THE ENVIRONMENT, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, AND RESPONSES TO SAME

Question 1. Ozone levels fluctuate naturally a great deal. This is caused by changes in global weather patterns, eruption of volcanoes and changes in the ultra-violet output of the sun on roughly a 10-11 year interval. Some scientists believe that because these natural fluctuations vary by unknown and unpredictable amounts they cannot be removed accurately. Yet all these natural effects must be removed in order to judge the manmade trend. Can you determine with scientific certainty the amount of variation caused by these factors? What is the margin of error in these determinations?

Response: It is not true that all periodic and episodic natural fluctuations have to be removed in order to be able to determine the magnitude of the human-induced trend. Periodic fluctuations in ozone caused by changes in season or the 11-year solar cycle can be removed from the record relatively well. The magnitude of solar cycle-induced changes in ozone have been estimated from ground-based Dobson data and the TOMS satellite data. The best estimate probably comes from the Dobson

network, where Reinsel et al. concluded that the maximum to minimum variation was $1.18 \pm 0.66\%$. Combining all data suggests that the peak-peak magnitude of the solar cycle effect is between 1 and 2%, significantly less than the derived human-induced trend. The magnitude of the seasonal cycle, depends on geographic location, and while much larger than the human-induced trend, is easy to remove quite accurately from the record because of the large number of repetitive cycles. If the fluctuations are more random, e.g., daily-weekly fluctuations caused by changes in "meteorological" conditions in the troposphere and stratosphere, they cannot be removed, but they are taken into account in the trend analysis using autocorrelation techniques. The reported uncertainty in the ozone trends is based on the statistics of the data, including natural fluctuations. If the fluctuations are episodic they cannot easily be removed as the magnitude of the effect varies from one eruption to another.

Question 2. In your testimony of August 1, you state that the larger-than-usual ozone depletions in 1992-1993 "could be attributed, at least in part" to eruptions from Mt. Pinatubo. If you can predict natural variations with some certainty, why don't you know the exact contributions of ozone depletion from Mt. Pinatubo's eruption?

Response: As stated in the answer to question #1 the magnitude of the effect of episodic volcanic eruptions cannot be predicted *a priori*. Each volcanic eruption will have a different effect on the ozone layer depending upon the height of injection the volcanic plume, the chemical composition of the plume, particle size, the geographic location of the plume, and the time of year of the eruption. My statement, which is taken from the recent international assessment, is based on intense ground-based, balloon, aircraft and satellite observations, coupled with laboratory studies and theoretical modeling. Based on observations and process studies, models were developed to simulate the effect of the Mt. Pinatubo eruption on the circulation and chemical composition of the stratosphere. The enhanced levels of sulfate aerosols caused by the eruption of Mt. Pinatubo caused an increase in the halogen-induced loss rate of stratospheric ozone. However, even with good observations of the chemical composition of the atmosphere, it is difficult to determine the exact magnitude of the effect of Mt. Pinatubo on ozone. Separating it from natural variability is difficult, which is why I used the term "at least in part".

Question 3. The most accurate measurements of ozone come from satellite experiments such as TOMS (Total Ozone Mapping Spectrometer) which began in the late 1970's. This is approximately 15 years of data. Many scientists claim that it is impossible to draw conclusions about the trends in ozone levels over this short period of time particularly since solar cycles run 11 to 12 years. How do you respond?

Response: Those scientists who claim that it is *impossible* to draw conclusions about the trends in ozone levels over a 15 year period have overstated the limitations of a 15 year record, especially if the magnitude of the trend is large (e.g., the spring-time Antarctic ozone hole). However, it is clear that the longer the record the easier it is to separate the effects of human activities from natural variability. The reported trends are not derived from TOMS satellite data alone. While the TOMS satellite provides the most geographically extensive set of column ozone measurements, the ground-based Dobson network provides accurate "long-term" measurements of column ozone over the land-masses in the northern hemisphere, particularly in the middle latitudes. The long-term trends are derived from the ground-based network for which many of the stations have reliable records dating from the late 1950s and early 1960s, i.e., 30-40 years, and there are some stations with accurate records going back into the 1930s, e.g., Arosa in Switzerland. It is the data from the long-term ground-based stations that allows separation of natural cycles in ozone (e.g., solar cycle) from human-induced trends. The satellite and ground-based data are in excellent accord, hence they can be combined to obtain an accurate global picture for the last 15 years. Also, the magnitude of solar cycle-induced changes in ozone are significantly less than the human-induced trends.

Question 4. What are the problems associated with using data collected at one location to draw conclusions about global ozone depletion. For instance, seasonal changes in ozone over Washington, DC can vary by as much as 20%.

Response: As you state, seasonal changes in ozone over Washington DC are significant. The total ozone over Washington DC varies from an April maximum of 372 DU (1979-1992) down to a November minimum of 286 DU, about a 26% variability. There are several reasons why deriving a global trend from a single station is inappropriate, which is why the international assessment used the ensemble of ground-based and satellite data measurements to deduce the ozone losses of about 3% per decade in summer, and 6% per decade, in winter at northern mid-latitudes. First, one has to be careful of calibration drifts in a single instrument, even though the WMO conducts periodic calibrations of all ground-based stations: more accurate

trends can be derived from an ensemble of stations. Second, natural ozone variability and ozone depletion varies with latitude and longitude. Consequently, if one wants a global perspective of ozone depletion then a single station is inadequate. The fact that ozone varies seasonally by as much as 20-30% is not relevant. The key issue is the trend in the mean value of ozone, which determines the average amount of UV-B radiation reaching the Earth's surface. One way to think about is the wealth of an individual. Most peoples bank account varies from one time of the month to another as the individual is paid and when the bills arrive. One measure of his wealth is the average bank balance, not the highest or lowest value. If something occurs which makes his average bank balance decrease, e.g., the rent increases over time while the salary stays constant, then his wealth decreases.

Question 5. Ozone concentrations rise and fall relative to the 11-year cycle of sunspots. If ozone levels fluctuate with sunspot activity, and more specifically, solar ultraviolet flux, then it is essential that one know the historical level of solar ultraviolet flux in order to draw conclusions about ozone trends. Do we know precisely the long term variations in the solar ultraviolet flux?

Response: We have "inferred" measurements from a variety of sources over different time scales, which suggest that the sun's output is relatively constant (sunspot number; F10.7—10.7 cm radio fluxes observed at Ottawa, Canada; He 108.3 nm flux; and Magnesium index). Because of the smallness of the solar cycle term, it doesn't really matter which of these indicators is used in trend analyses.

Question 6. If ozone is being depleted. UV-B should be increasing on the earth's surface, correct. Yet your testimony states that "variation introduced by clouds and other factors have precluded the unequivocal identification of a long term trend in surface UV radiation (P. 3). Could it also be possible that there is no long term upward trend in UV-B radiation?

Response: It is highly unlikely that there is no long-term trend in UV-B. This conclusion is based on the following lines of evidence: (i) measurements in Antarctica, Australia, Canada and Europe have shown that under clear sky conditions when column ozone decreases the amount of UV-B radiation increases by the amount expected from theory; (ii) statistically significant (2-sigma) UV-B trends during spring, early summer and late autumn at latitudes poleward of 40 degrees can be derived from TOMS satellite measurements; and (iii) satellite estimated UV-B fluxes agree very well with ground-based measurements for all observing conditions (cloud plus aerosols and clear sky).

The assessment noted that a decrease in ozone is expected to increase the amount of UV-B radiation reaching the Earth's surface assuming no compensating effects such as a "global increase in cloud cover or aerosol loading". Recent studies based on TOMS reflectivity data have shown that there has been no long-term global change in cloudiness plus aerosols from 1978-1993 to an accuracy of 1%. UV-B trends estimated with and without cloud effects are almost the same.

The UV-B network was limited to only a few polluted sites in the USA, hence not representative of the USA, let alone other locations around the globe. Also, the magnitude of ozone depletion between 1974 and 1985 over the USA was only about 2% in summer and 5% in winter, a level very difficult to detect given the limited number of sites, local pollution problems, high variability of UV-B induced by variations in ozone and cloud cover, and the low sensitivity of the instruments. J. DeLuisi of NOAA has concluded that the calibration of the monitors was so flawed that no reliable trends can be determined from the data. The signal from UV-B is so noisy, due to day-to-day changes and due to the major shortcomings in the calibration procedures, that no reliable trends analysis is possible. The UV-B flux may have even increased (as expected) over that time period, but it would not have been detected by the network—it would have been overwhelmed by the calibration problems. The original data sets and documentation for the network no longer exists, so it is impossible to reconstruct an accurate data base from the monitoring network.

Question 7. Measurements of UV-B radiation over populated areas made between 1974 and 1985 either decreased or did not change. After 1985 these measurements were discontinued. Isn't it true that our only long term systematic measurement of UV-B radiation then shows no increase?

Response: See the answer to question 6. The only so-called long-term ground-based measurements show no systematic increase, but the validity of the entire set of measurements must be questioned. However, the 15-year TOMS satellite measurements do indicate trends of ground-level UV-B at during certain seasons poleward of 40 degrees.

Question 8. Please state what pollutants might interfere with these UV-B measurements. Between 1974 and 1985, please state whether these pollutants that would interfere with these measurements were increasing or decreasing? Please include supporting documentation.

Response: There are a number of pollutants, and other factors, that may influence the intensity of UV-B measurements at the surface. In considering these factors, it is important to note that changes in local conditions would be most significant, and not national trends for which data may be available.

Factor	Trend from 1974-85
1. Cloud cover	Not known, but clouds have a major effect on UV
2. Total column cover	Data available from the Dobson network
3. Ground level ozone	Slight downward trend: (EPA National Trends Report, 1986)
4. Haze	Slight downward trend: (Visibility data (Husar) in NAPAP Report)
5. SO ₂	Slight downward trend: (EPA National Trends Report, 1986)

Question 9. What systematic studies is EPA currently doing to verify that UV-B is increasing? Are these studies being conducted in population areas? If not, why not?

Response: EPA and USDA are both conducting UV-B measurements under the auspices of a coordinated program of the USGCRP. EPA is conducting monitoring primarily in populated areas (4 out of its current 5 sites). "Clean" sites (generally not highly populated) are also needed to provide background data. The EPA network is designed to provide not only data on intensities and trends, but to identify the causes of any changes that may be observed. To accomplish this, spectral radiometers are used to measure the changes as a function of wavelength (since the various factors have different effects at different wavelengths) and the UV measurements are teamed with other measurements of pollutants to account for their impact. Calibration procedures are also carefully done, in coordination with NIST and other Agencies under CENR.

Question 10. The major cost benefit in EPA's Regulatory Impact Analysis for the phaseout of ozone depleting substances was the avoidance of malignant melanoma. Yet, Dr. Richard Setlow from Brookhaven National Laboratories has determined that 90-95 percent of melanomas in animal models is caused by the spectrum UV-A and visible light. What evidence do you have that UV-B causes malignant melanoma?

Response: The major cost benefit in the Regulatory Impact Analysis (RIA) was not the avoidance of melanoma, it was the avoidance of nonmelanoma. Conclusive evidence exists linking non-melanoma skin cancer to increases in UV-B radiation. While only a small percentage (less than 1%) of cases of nonmelanoma skin cancer result in fatalities, the large number of people effected makes the total impact significant. As regards to the cited work of Dr. Setlow: Immature crossbred fish of a species prone to developing a form of melanoma were exposed to wavelengths of UV-A, UV-B and even visible light. The most effective wavelengths causing melanoma in this experiment were those in the UV-B range. The least effective wavelengths were in the UV-A range. The surprising finding was that UV-A was at all effective. Based on the relative effectiveness and magnitude of UV-B compared to UV-A, the role of UV-B on melanoma would be greater than that suggested by Dr. Setlow. In addition, two control groups were discussed in the paper. Comparison with one control group indicated no effect of UV-A light. The other control group comparison showed this effect. Since there is no historical control data for this particular backcross of fish, it is difficult to evaluate the finding of UV-A effectiveness. To date, no other researcher has reported a similar finding.

Compelling evidence that UV-B causes melanoma is evidenced by the experience of patients with Xeroderma Pigmentosum. People with this disease cannot repair UV-B-induced skin DNA damage. Their melanoma rates are 2000 times greater by age 20 than the normal population.

Native Australians of British origin, experience a doubling in melanoma incidence as compared to British immigrants. The same pattern is true in Israeli natives versus European immigrants to Israel. Since the UV-B but not UV-A changes significantly by latitude, these epidemiological studies demonstrate that the UV-B component of sunlight is important in the pathogenesis of melanoma.

Question 11. Dr. Singer has pointed out in his testimony that a 5-percent depletion in ozone would result in a 10 percent increase in UV radiation. He states this is comparable to a person moving from Washington, DC to Richmond, Virginia. Do you agree that ozone depletion currently poses the same risk as moving from Washington, DC to Richmond, VA?

Response: Ozone depletion currently poses a small risk which may be comparable to moving South by a hundred miles or so. The reason this risk is so low is that the Montreal Protocol has been in effect. If the Montreal Protocol had not been in

existence we would be talking about future increases in UV-B radiation of possibly 40-50 percent, and the comparable distance would be more like a thousand miles or greater. If there were an increase in UV radiation so that people living in Boston experienced an equivalent of the radiation they expect when they visit Miami, most people would consider that change to be highly significant if not catastrophic. There is a big difference in skin cancer rates between cities in the northern half of the US and those in the Southern half. For example, the skin cancer rates for male anglos in Albuquerque were approximately 700/100,000 vs 150/100,000 in Seattle, a factor of 5 increase. (See Nonmelanoma Skin Cancer UV-B Effects by J. Scotto in Effects of Changes in Stratospheric Ozone and Global Climate, Vol 2: Stratospheric ozone, 1986). Thus, health impacts of increases ozone depletion would be substantial.

The Table below shows how ozone has changed at selected cities within the USA

City	Latitude	Ozone in 1982 (DU)	Ozone in 1992 (DU)	% Loss
Caribou	45.87	357.4	339.9	4.90
Boston	42.30	341.3	324.5	4.92
New York	40.75	336.2	320.8	4.58
Philadelphia	39.95	333.2	318.7	4.35
Washington DC	38.90	329.2	315.0	4.31
Walllops Island	37.85	324.4	310.8	4.19
Tallahassee	30.43	301.4	288.1	4.41
Cape Canaveral	28.60	295.1	284.2	3.69
Miami	25.80	287.1	278.7	2.93

Moving south by 1 degree of latitude will decrease the solar zenith angle by about 1 degree so that the impact of the change in ozone between 1982 and 1992 appears to be equivalent to moving south 2-3 degrees.

Question 12. Increased UV-B radiation is said to have a detrimental effect on crops. However, Florida is exposed, Dr. Singer testified, to a 200 percent increase of UV radiation as opposed to New York. What effects on crops do you find in comparing Florida and more northern states?

Response: Given the wide variation in many factors including soil composition, temperature, agricultural practices, rainfall, humidity, etc., no studies exist directly comparing the impacts of UV-B radiation alone on crops grown in Florida and New York. However, if all other factors were held constant, based on studies done to date, you would expect that agricultural productivity in Florida would be adversely affected by higher UV-B incidence.

Question 13. What research have you done into the relationship between heat and mortality rates? Do you agree that the cost of air conditioning will increase, making it more difficult for some to afford air conditioning installation, maintenance, etc?

Response: Studies recently have been conducted, in the context of concerns about possible warmer temperatures associated with increases in carbon dioxide and other greenhouse gases, that suggest increased mortality can result from increases in temperatures (the recent July heatwave clearly resulted in hundreds of deaths in Chicago alone, especially among the elderly). I cannot comment directly on changes in the cost of air conditioning. However, based on discussions with EPA and industry, I can report to you that production of HCFC-22, the refrigerant used in residential air conditioning, is not controlled until 2010 for use in new equipment (2020 for servicing existing equipment) and therefore the costs of new air conditioning equipment should not have been affected. Moreover, alternative refrigerants currently under development appear to improve energy efficiency and therefore would substantially reduce costs to consumers of air conditioning in the future. While requirements to recycle HCFCs currently are required by the Clean Air Act and may increase servicing costs, they also result in improved maintenance and equipment performance and therefore have economic and comfort benefits for consumers.

Question 14. Do you agree that the cost of fire suppression will increase due to the regulation and manufacturing phase-out of fire suppression chemicals such as bromine, raising the risk of mortality by fire?

Response: No. Given the improvements in fire protection strategies and engineering, the wide variety of choices of systems, and the availability of recycled halon, the risk of mortality by fire is not rising. Halon was oversold into applications where it was often unnecessary and sometimes when it was not even the best choice for fire protection. The phaseout of halon is causing many designers, engineers and even insurance companies to reexamine fire protection strategies. Thus, many former user of halon are reverting to traditional water sprinklers, dry chemical and

carbon dioxide, and are adopting improved and advanced fire detection, and improved engineering, options of which many are less expensive. Where these traditional and advanced approaches are not appropriate, users are installing the new halon substitutes, including water mist systems, inert gas systems as well as new halocarbon systems. While some of these new systems are indeed more expensive than halon systems were, they are being adopted whenever necessary and typically represent an insignificant portion of total project costs. Thus, there is no evidence whatsoever that the risks of increased mortality by fire have increased.

STRATOSPHERIC OZONE DEPLETION ESSAY FOR THE RECORD

BY DR. ROBERT T. WATSON

The need for sound science and risk assessment as the basis for regulatory policy is absolutely critical in this and other environmental issues. I believe that the scientific basis for decision-making in the ozone issue is as good, and is probably better, than for any other environmental issue. This is largely because of the long-term commitment to a sound scientific research program by both Congress, and by this and previous Administrations.

Relationship Between Ozone and Ultraviolet Radiation: Before discussing the issue of ozone depletion, and its consequences, let me first outline the relationship between ozone and ultraviolet radiation. UV-B radiation is radiation of less than 320 nanometers (nm)—invisible to the eye—and is largely blocked from reaching the Earth's surface by atmospheric ozone. Decreases in ozone will lead to an increase in UV-B radiation reaching the Earth's surface. UV-A radiation occurs at wavelengths longer than 320 nm and is not blocked from reaching the Earth's surface by ozone, hence decreases in ozone do not affect the amount of UV-A reaching the Earth's surface.

Why is Ozone Depletion Bad: The issue of stratospheric ozone depletion is of critical importance to the health of Americans. Increased levels of ultraviolet radiation (UV-B) reaching the Earth's surface *will*, not may, have adverse consequences for human health, in particular an increase in the incidence non-melanoma skin cancer (between half and one percent of all cases are fatal), probably melanoma skin cancer (with a very high fatality rate), eye cataracts, and a possible suppression of the immune-response system. For every 1% sustained increase in UV-B radiation there will be a 2% increase in the incidence of non-melanoma skin cancer in *light-skinned* people. The current incidence rate of non-melanoma skin cancer in the United States is approximately 750,000 new cases each year, of which between 0.5 and 1% of these cases will result in death. Even those cases that do not result in death, are a significant cost to health care services. The incidence of non-melanoma increases with decreasing latitude: i.e., the incidence of cases is greatest in the Southern part of the United States, e.g., Texas, Florida, and Southern California—the areas that most use methyl bromide. As you will see later, ozone depletion is expected to peak within the next few years at about 6-7% over Northern mid-latitudes (including the United States) in summer/fall and roughly double in winter/spring. Let us assume that the ozone layer fully recovers over the next 60 years, then the *average* summer-time ozone depletion will be about 3-4%. This will lead to a 6-8% increase in new cases of skin cancer (over 50,000 ozone-depletion induced new cases per year) in the United States, and an increase in the yearly death rate of about (250-500). As you can see, this is an important public health issue for the United States.

While there is some debate whether melanoma skin cancer (usually fatal) is caused by UV-B radiation, or UV-A radiation, if it is caused by UV-B radiation, then ozone depletion would cause an increase in this deadly form of skin cancer. Compelling evidence that UV-B causes melanoma is evidenced by the experience of patients with Xeroderma Pigmentosum. People with this disease cannot repair UV-B-induced skin DNA damage. Their melanoma rates are 2000 times greater by age 20 than the normal population. In addition, native Australians of British origin, experience a doubling in melanoma incidence as compared to British immigrants. The same pattern is true in Israeli natives versus European immigrants to Israel. Since the UV-B but not UV-A changes significantly by latitude, these epidemiological studies demonstrate that the UV-B component of sunlight is important in the pathogenesis of melanoma.

It should also be noted that increased levels of UV-B radiation adversely affects ecological systems and air quality.

Simple, but Accurate Picture of Stratospheric Ozone: How the System Works

- Long-lived chlorine (CFCs, carbon tetrachloride) and bromine (halons) containing chemicals are released at the Earth's surface due to human activities. They have no significant removal processes in the lower atmosphere, consequently, weather patterns distribute them fairly uniformly over the whole globe and transport them up into the stratosphere where the bulk of the Earth's protective ozone layer resides.
- Shorter-lived chemicals such as methylchloroform (a source of chlorine) and methyl bromide (a source of bromine) do have removal processes in the lower atmosphere, hence only a fraction of these chemicals emitted into the atmosphere ever reach the ozone layer in the stratosphere. Even these chemicals are relatively well mixed throughout the globe, with slightly higher concentrations in the northern hemisphere where most of the emissions occur.
- These long- and shorter-lived organic halocarbons are broken down by photochemical processes in the stratosphere into what we call "reservoir and photochemically active" inorganic species. The photochemically active species (atoms and radicals) then catalytically destroy stratospheric ozone through a series of chemical processes. These chemicals are very efficient in destroying ozone: each chlorine molecule can destroy tens of thousands of ozone molecules, and bromine is even more efficient in destroying ozone. In fact bromine is at least 50 times more efficient than chlorine in destroying ozone than chlorine per molecule.
- Antarctica is a very special situation. Chlorine and bromine are much more efficient in destroying ozone over Antarctica than over mid-latitudes because of the unique meteorological conditions in the stratosphere. These unique meteorological conditions produce very cold temperatures which causes water vapor to condense into ice crystals. These ice crystals transform most of the chlorine in the stratosphere from reservoir species into "photochemically active" forms that can destroy ozone in the presence of sunlight. Hence a much greater percentage of chlorine is available to destroy ozone over Antarctica than over mid-latitudes.
- A reduction in stratospheric ozone then allows more UV-B radiation to reach the Earth's surface, with adverse consequences for human health, ecological systems, and air quality.

Key Conclusions Regarding Stratospheric Ozone:

- There is no doubt that the major sources of atmospheric chlorine and bromine are from human activities (e.g., CFCs, Halons and methyl bromide), not from natural sources such as volcanoes or sea spray.
- There is no doubt that downward trends of ozone are occurring at all latitudes, except the tropics, during all seasons. Extensive ground-based data and satellite data have shown that since 1970 ozone has decreased by about 5-6% in summer and 9-11% in winter/spring in northern mid-latitudes, and by 8-9% at southern mid-latitudes on a year-round basis. Natural periodic and episodic fluctuations are taken into account (solar cycle, seasonal, volcanic, etc.).
- There is no doubt that the spring-time Antarctic ozone hole is due to anthropogenic chlorine and bromine. This conclusion is based on combining ground, aircraft, balloon and satellite data, with laboratory data and theoretical modeling.
- The weight of scientific evidence strongly suggests that the observed mid-latitude downward trends of ozone are due in large part to anthropogenic chlorine and bromine. This conclusion is also based on combining ground, aircraft, balloon and satellite data, with laboratory data and theoretical modeling.
- The rate of increase of atmospheric chlorine and bromine has slowed considerably in recent years demonstrating the effectiveness of the Montreal Protocol and its amendments. Even so, the mid-latitude ozone loss and the hole over Antarctica are not expected to disappear until the middle of the next century because of the very long atmospheric residence times for the CFCs and halons, i.e., human emissions between 1960 and today will affect the health of future generations.
- During periods of low ozone, stations in Antarctica, Australia and mountainous regions in Europe, have shown that as ozone levels decrease ground-level UV-B increases as expected. In addition, TOMS satellite data also indicates a trend in ground-level UV-B radiation in some seasons poleward of 40 degrees.
- Increases in UV-B radiation result in adverse consequences for human health, in particular an increase in the incidence eye cataracts, and non-melanoma skin cancer where between half and one percent of all cases leads to death. In addition, there could be a suppression of the immune-response system and an increase in the incidence of melanoma skin cancer, which has a very high fatality rate.

Role of Methyl Bromide:

- Methyl bromide continues to be viewed as a significant ozone-depleting compound:
 - The major sources of methyl bromide are: natural (the ocean: 60 to 160 ktonnes/yr); and anthropogenic (agricultural usage: 20 to 60 ktonnes/yr, with 50% being emitted to the atmosphere; biomass burning: 20 to 60 ktonnes/yr; and the exhaust of automobiles using lead gasoline: up to 22 ktonnes/yr).
 - The best estimate is that about 40% of the source of methyl bromide is anthropogenic, with the major uncertainty being the size of the ocean source.
 - The overall atmospheric lifetime due to atmospheric and ocean loss processes is 1.3 yr with a range of 0.8 to 1.7 yr. Recent data suggests that this value may be lower if there is a significant soil sink.
 - The efficiency of bromine is likely to be about 50 times greater than the efficiency of chlorine on an atom-for-atom basis.
 - The calculated Ozone Depletion Potential (ODP) for CH_3Br is currently estimated to be 0.6.
- If all emissions of methyl bromide from agricultural, structural, and industrial activities were to be eliminated in the year 2001 (i.e., a global ban on methyl bromide from these sectors), then the integrated ozone loss is predicted to be 13% less over the next 50 years relative to full compliance to the Amendments and Adjustments of the Montreal Protocol. The contribution of U.S. farmers is between one-third and one-half of this amount, i.e., 4-6%.

COMMITTEE ON COMMERCE,
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS,
October 4, 1995.

The Honorable MARY D. NICHOLS,
*Assistant Administrator for Air and Radiation,
Environmental Protection Agency,
Washington, D.C. 20460*

DEAR MS. NICHOLS: On August 1, 1995, you testified before the Subcommittee on Oversight and Investigations regarding Title VI of the 1990 Clean Air Act Amendments.

During the course of your testimony, several Members of Congress either asked for material to be submitted for the record or for the opportunity to submit additional questions. This letter is intended to convey these requests.

First, during the questioning of your panel, Mr. Wyden requested further information regarding your statement that the Office of Pesticides and Toxics had a "streamlined process" which was available for substitutes to methyl bromide. Mr. Wyden asked that material on this matter be submitted for the record.

Second, Mr. Bilbray also posed several questions concerning halon replacements. In specific, his concerns centered on the safety of substitutes and their availability for use in confined spaces. Please provide additional information on this subject.

Third, although he was not able to be present for the hearing, Mr. Oxley expressed through a written statement several concerns regarding methyl bromide and the contemplated phaseout of this substance. His statement, which is attached to this letter, also contains a question which he wished to be addressed to EPA during the course of our hearing. Since the Subcommittee granted general leave for additional questions, I would request your direct response to the concerns and question posed by Mr. Oxley.

Finally, Mr. Bilbray also questioned the legal authority of EPA to grant "essential use" exemptions under the present language of the Clean Air Act. You indicated at the hearing you were not able to answer this question "at this time."

(1) Please provide the Subcommittee with a legal analysis of EPA's *present* authority to grant an "essential use" exemption for methyl bromide under the Clean Air Act. Please provide any relevant case law and previous Agency opinion which support your position.

(2) Does EPA disagree with the legal analysis of the Department of Agriculture as noted in the May 17, 1993 letter from Deputy Secretary Richard Rominger to Secretary Browner? If so, please specify what precise objections that EPA holds with respect to the legal opinion rendered by the Department of Agriculture.

(3) If EPA concludes that the Agency does not presently have legal authority to grant an essential use exemption for methyl bromide, please provide the Subcommittee with draft legislative language designed to provide such authority.

Thank you for your prompt attention to these requests. Please respond in writing within 30 calendar days.

Sincerely,

JOE BARTON,
Chairman,

Subcommittee on Oversight and Investigations.

cc: The Honorable Ron Wyden, Ranking Minority member

U.S. ENVIRONMENTAL PROTECTION AGENCY,
WASHINGTON, D.C. 20460,
November 20, 1995.

Honorable JOE BARTON,
Chairman, Oversight and Investigations Subcommittee,
House Committee on Commerce,
House of Representatives,
Washington, D.C. 20515-3504.

DEAR MR. CHAIRMAN: Thank you for your letter of October 10, 1995, forwarding questions raised by other members of the Subcommittee about methyl bromide. I appreciate the opportunity to provide you with the additional information you requested concerning the August 1, 1995 Subcommittee on Oversight and Investigations regarding Title VI of the 1990 Clean Air Act Amendments.

Concerning the first request of your letter, please find the enclosed information for Mr. Wyden on the Environmental Protection Agency (EPA) Office of Prevention, Pesticides and Toxic Substances' program to give priority review to methyl bromide alternatives. This concerns his request for further information on the EPA streamlined processes to accelerate the registration of alternatives to methyl bromide. The enclosed document, Pesticide Regulation (PR) Notice 95-4 dated July 13, 1995, fully describes the background to this program and how it is currently being implemented to insure that new alternatives to methyl bromide will be available before the phase out date.

In regard to the query of Mr. Bilbray regarding halon replacements, several chemical agents and alternative technologies are available for fire suppression applications. The most popular agents for enclosed, occupied areas include Great Lakes Chemical Corporation's FM-200 (HFC-227ea) and Ansul Corporation's Inergen (Inert Gas). Other available agents include DuPont's HFC-23 and 3M's CEA-410. All these agents are safe for use in occupied areas. Insurance companies no longer require the use of a gaseous agent in computer rooms, but in many cases they urge consumers to adopt traditional water sprinklers with advanced detection systems.

I appreciate the inclusion of the letter and issues statement of Mr. Oxley, and understand his concerns; while an immediate phase out of methyl bromide may indeed be inadvisable, in fact five full years remain before the production and importation of this pesticide cease. I am confident that we will be able to make significant progress during this time in replacing the vast majority of methyl bromide uses. Already there are technical alternatives for 90 percent of methyl bromide uses. I have enclosed a recent EPA publication on examples of methyl bromide alternatives. However, as we approach the phase out date of 2001, if there are some uses of methyl bromide that do not have viable alternatives, EPA is committed to work with all affected stakeholders to achieve a reasonable resolution of this matter.

In regard to the specific points that Mr. Oxley raised on EPA staff expertise, let me state unequivocally that EPA methyl bromide program staff are well versed on both the uses of methyl bromide, and the alternatives to this pesticide. Our staff's educational background include graduate level degrees in Agriculture and Entomology as well as considerable experience in the field of pest management. Over the past three years, our staff has made visits to the major methyl bromide use areas to more fully understand how and why methyl bromide is used, as well as to work directly with users on developing good alternatives. We fully understand the potential implications of this issue, and are committed to insuring that American agriculture has viable alternatives by the phase out date.

Finally, in regard to your query on the legal authority of EPA to grant "essential use" exemptions, we are committed to solving this problem by making an appropriately designed "safety valve" available. The key issues are what criteria should be used to determine critical agricultural uses, and what process should be set out for making applications and responding to them. We are consulting with stakeholders—both methyl bromide users and environmental organizations—in developing the appropriate criteria and process. These issues must be addressed first whether one is pursuing a safety valve through new legislation or under existing authority.

We recognize the importance of methyl bromide to the U.S. agricultural community, and will strive to minimize the effect of any actions that may be required under the Clean Air Act. In fact, the final rule was specifically structured to minimize the impact to the methyl bromide users by not requiring any interim reductions in production and by not imposing product labeling.

In addition, the rule allows the maximum period permitted under the statute prior to a phase out. We will continue to carry out our statutory responsibility to protect the ozone layer in a manner which takes into consideration the needs of the methyl bromide users.

I appreciate your interest in this issue.

Sincerely yours,

MARY D. NICHOLS,

Assistant Administrator for Air and Radiation,

Enclosures

GRAINGER FARMS INC.,
PALMETTO, FLORIDA,
October 9, 1995.

Representative JOE BARTON,
*Chairman, Oversight & Investigations Subcommittee,
House Commerce Committee,
2125 Rayburn House Office Building,
Washington, DC 20515.*

DEAR MR. BARTON: In July when I appeared before the Subcommittee, I promised to provide to you, at a later time, information in the differences between growing grapes and say, strawberries and tomatoes—in the context of methyl bromide.

There are two fundamental differences:

- The first is the nature of the crops. Grapevines may remain in place for decades. Only when new rootstock is planted is methyl bromide used. With tomatoes, strawberries and other row crops, new crops may be planted more than once a year. Methyl bromide fumigation is likely to occur nearly as often.
- The second is weather. In Florida, we have no real winter and, as such, pests flourish. We have no choice but to use a pesticide as strong as methyl bromide. Grapes tend to be grown in far cooler climates and do not face the range and strength of pests we see.

At the same hearing, Representative Furse asked why American growers insist on retaining methyl bromide when nations such as Iceland and Norway have so easily banned the chemical. I have checked every source imaginable, and have found no evidence that Iceland, Norway and other Scandinavian nations export any crops. As a tomato grower, I promise you that I will be happy to compete against Iceland all day. Mexico is another story and the tomato growers in that country have no intention of giving up methyl bromide.

I hope this information is useful to the Subcommittee in its determinations.

Sincerely,

JAMES R. GRAINGER II.

COMPETITIVE ENTERPRISE INSTITUTE,
August 3, 1995.

Honorable JOE BARTON,
*United States House of Representatives,
Washington, DC 20515-4306.*

DEAR CHAIRMAN BARTON: In her written statement to this committee on August 1, 1995, EPA Assistant Administrator Mary Nichols makes reference to cost estimates of the chlorofluorocarbon (CFC) phaseout that I produced for the Competitive Enterprise Institute. She referred to my estimates as "highly inflated" and misrepresented both my methodology and the real-world data on the costs of the CFC phaseout. As I was not able to testify at the August 1 hearing, I would ask that you include this response to Ms. Nichols' critique in the hearing record.

In "The High Cost of Cool," I estimated that the total cost of the CFC phaseout will reach \$44.5 to \$99.4 billion over the next decade. This estimate is based upon a careful analysis of the real-world effects of the phaseout, and what replacement refrigerants and equipment will actually cost consumers in the marketplace. The EPA has yet to conduct such a study.

In her written statement, Ms. Nichols states that "erroneously assume that all existing air-conditioning and refrigeration equipment would have to be discarded and replaced immediately." This is simply not true. I merely assume that much of this equipment will have to be prematurely replaced or retrofitted over the next several years. There is no requirement to stop using CFCs after the January 1, 1996 phase-out deadline. But, the evidence indicates that CFCs will soon become prohibitively expensive. Ms. Nichols asserts that "existing equipment can remain in use indefinitely because substantial amounts of recycled CFCs will be available to repair it." Unfortunately, this is not true. The quantity of usable refrigerant being recycled is very small, and is not likely to last very long. The air-conditioning and refrigeration trade press is replete with articles such as "Recovered Refrigerant: Where Is It?" (Air Conditioning, Heating, and Refrigeration News, May 16, 1994). My cost estimates are based on the realistic assumption that the existing stocks of CFCs will diminish after the phaseout date, and shortages will occur by 1997 or 1998, at which time large volumes of perfectly good CFC equipment will indeed have to be scrapped or retrofitted, at high cost.

Ms. Nichols makes several other assertions that have no support, particularly regarding the cost impact of the phaseout on motor vehicle air-conditioners. She claims that "the added cost of shifting to HFC-134a retrofitting should be under \$100." Actual costs of HFC-134a retrofits average well over \$200, and many experts think they will not work very well. I do not include retrofit costs in my estimate, because I believe that few motor vehicle owners will choose this costly option.

Over 20 million car and truck air-conditioners are repaired each year. The cost of an average repair has increased by as much \$100. Therefore, EPA's total cost estimate of \$4 billion for the entire air-conditioning and refrigeration sector has probably already been exceeded by motor vehicle costs alone. Anyone who has had their car air-conditioner fixed recently must be puzzled by EPA's optimistic assessments of the cost of the CFC phaseout.

Ms. Nichols also ignores the problems with the new non-CFC equipment, instead implying that this new equipment is superior to its CFC predecessors. She states that the new equipment is "highly energy-efficient." But she fails to mention that the energy efficiency gains in some types of equipment have nothing to do with the use of non-CFC refrigerants. These gains are the result of the use of more efficient motors to drive these systems, as well as other hardware improvements. In fact, since CFCs are thermodynamically superior to the non-CFCs thus far developed, a comparable CFC system using these state of the art improvements would be considerably more efficient than a non-CFC system, thus there is a relative energy penalty.

The new non-CFC equipment is in many respects inferior to its CFC-using counterparts. The accelerated CFC phaseout has not allowed enough time to fully develop these new systems and they are being rushed to market with many technical problems yet unsolved. Few knowledgeable engineers believe these new systems will be as reliable as CFC systems, thus maintenance costs will be higher. And there is very little reason to believe that these systems will last as long as CFC systems.

The EPA's estimates of the cost of the CFC phaseout directly contradict the real world experiences being faced by owners of CFC-using equipment. Thus far, the estimate of \$44.5 to \$99.4 billion through 2004 is right on schedule. If anything, the real world costs will be even higher than my estimates, as I excluded those costs that are highly uncertain or speculative.

To further clarify the record, I have enclosed a copy of my study for your reference, and would be happy to answer any additional questions on this matter that you or your staff may have.

Thank you for your consideration.

Sincerely,

BEN LIEBERMAN.

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